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ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

The Beaudry Duplex Power Press.

The inventor of this press is the well-known inventor of the Beaudry power hammer. The essential features of the press are two plungers on a single crank shaft, so connected that either plunger may be worked independently, or both may be run together. The arrangement is a combination of shear press or punch, either or both being operated for either purpose.

Through its whole stroke the plunger is under the perfect control of the operator. By a simple device the plungers can be lowered to meet the dies or to any other point of the stroke while the shaft is running, and thus the punch may be brought exactly to a prick point or scratch mark.

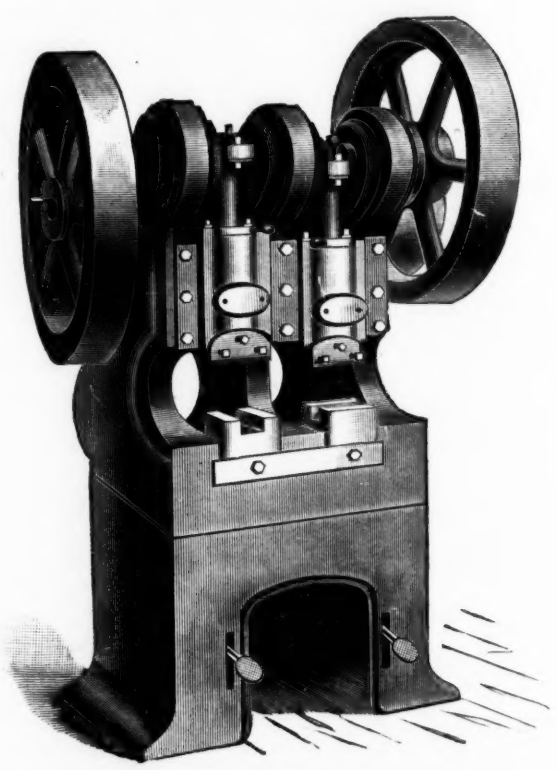
The operator controls the plungers through a treadle, leaving his hands free to feed the machine.

The shears can be put in either way so that large plates can be cut.

These presses are designed in a thoroughly practical manner for durability and hard work. All the parts are of ample size and strength for the work they have to do. The crank shaft is made of the best hammered steel with large bearing surfaces.

These machines are built in several sizes and are intended for use in boiler shops, cutlery shops, blacksmith shops, manufactories of stamped, pressed and other wares.

The manufacturers are Beaudry & Co., Mason Building, Kilby street, Boston, Mass.



DUPLEX POWER PRESS.

The Keystone Radial Drill Press.

The machine illustrated herewith is intended for a large range of work. It takes in a pulley up to four feet diameter, and may be used for boring small cylinders, and similar work.

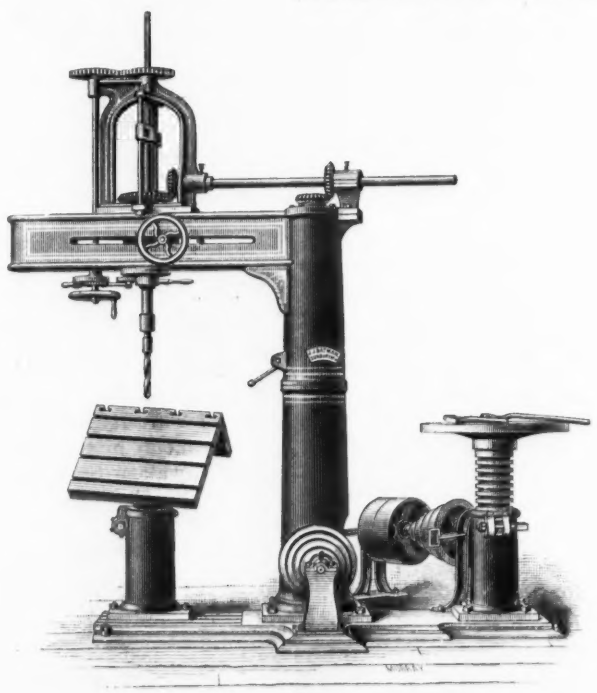
The feed screw will feed 14 inches, and has adjustable automatic feed. The back gearing is all enclosed.

The circular table is 24 inches diameter, and is bored to receive bushes for boring bars. This table can be raised or lowered without being turned around.

The square tilting table slips in slotted side of bed, and can be quickly removed. It is convenient for drilling work at any desired angle.

The drill illustrated has radius of 48 inches, giving a distance between column and spindle of 34 inches. The column is 12 inches diameter, and 6 feet high. The entire height from floor to top of feed screw is 8 feet 10 inches; weight 2,600 lbs.

The manufacturer is J. J. Batman, Sunbury, Pa.



RADIAL DRILL PRESS.

A Remarkable Rain Storm.

It is going the rounds of the press that in the event of a rain storm extending from New York to San Francisco the telegraph wire over the route would contract 120 miles, and upon this an argument for the necessity of underground wires is built up. We fear that unless an argument is established upon better premises, it will have but little weight in putting down the poles. If the distance, as the wire runs, from New York to San Francisco is taken at 4,000 miles—which is too great, but a few miles more or less are of no consequence—the contraction would be, by the above, one part in 33¼. According to good authority, wire similar to telegraph wire will expand or contract one part in each 146,340 parts for each degree change of temperature. To decrease the length of the wire by 120 miles would require a change in temperature of 4,390 degrees. It will be readily granted that a rain storm that brought about such a change in temperature would be a remarkable one.

Henry D. Coggswell, of San Francisco, has given one million dollars for the endowment of a trade school in that city. This must be a very satisfactory way for a millionaire to spend his money.

M. N. Forney, in his *Railroad and Engineering Journal*, in the course of a trenchant editorial on the Bussey Bridge, says:

"Directors and traffic managers are generally persons who have had an exclusively mercantile training, the value and importance of which is not questioned. But those who have been educated exclusively in the school of barter very often have a defective appreciation of the inexorable character of physical laws. Somehow or other that kind of people often find it difficult to rid themselves of a secret, lurking feeling that by skillful finesse they can 'corner' the laws of nature. This is often amusingly illustrated by the way new inventions are 'promoted' in Wall street and its precincts. Those who engage in such projects sometimes seem to regard the scientific principles on which the invention depends, as a mere incident which can always be twisted to suit their purposes by a hired expert. In the same way, successful grocers and 'bankers' feel, that by dispensing with the services of an engineer, at a fair salary, and delegating his duties to a 'gang boss,' that they can 'beat' the law of gravitation and the principles of statics. These often take their revenge, as they did on the Boston & Providence Railroad, and as they have done and will do in other like cases."

Engineering and Mechanical Notes.

BY F. F. HEMENWAY.

CHIMNEYS FOR BOILERS.

If a connecting cock is opened between two vessels each containing air or other fluid, but at different pressures, the fluid will pass from that vessel in which the pressure is highest to that in which it is lowest, the theoretical velocity of flow being due to the difference in height of two columns of the fluid, each column being high enough to produce the pressure, or density, in the vessel containing it. The velocity is not, however, directly as the height, but as the square root of the height, the matter being referable to the law of falling bodies. When air is heated its density is correspondingly reduced, being only about half as much at 550° as at 60°.

In a chimney the column of air is heated, and rarefied, and the effort of the denser air outside to force its way into this partial vacuum is all there is of chimney draft. But there is friction of the gases in their way to the chimney, and particularly there is loss of effect in the effort of the air to force its way through the fuel on the grate, and this materially modifies calculations that are made on a purely theoretical basis. In this, as in all other things, results likely to obtain must be predicated more from practice than from any other consideration. To burn a definite quantity of coal we must supply a quantity of air, the quantity being determined entirely by practice, since here again theory is quite at fault.

Still, as a general proposition we must work from certain scientific facts, modifying the conclusions arrived at by experience. As the velocity with which the external air will tend to flow to the chimney is due to the difference between the weight of the column of air in the chimney and a column of external air of the same dimensions, it appears to follow that the hotter and hence lighter, the air in the chimney, the better the draft; also that the higher the chimney the better the draft.

This is true in regard to internal chimney temperature, up to a point where the volume of air and gases will become so great, by expansion, that further heat will increase the volume till not so much weight of gases will be discharged through a flue of given dimensions. As this temperature is not likely to be reached in the case of a steam boiler, it needs no attention.

In regard to height of chimney, the economical limit is comparatively soon reached, because the draft power varies as the square root of the height. To double the draft power of a chimney of 100 feet in height it

will be necessary to increase the height to 400 feet.

Horizontal Flues.

The effect of horizontal flues leading considerable distance to chimney is to lessen the draft. Such flues ought to be of an area at least one-quarter greater than that of the chimney. When horizontal flues are 200 feet in length the area of chimney should be increased by 15 per cent.

The Table.

The accompanying table is calculated for a circuit of 100 feet, measuring along the course of the gases from the furnace to the chimney. Account is taken of the loss due to friction, which reduces the effective area of chimney, this reduction being proportionately greater in small than in large chimneys.

The rating is for the amount of coal burned, not by horse-power. Twice as much coal may be required to evaporate a given quantity of water in one boiler as in another, and twice as much water may be required per horse-power in one engine as in another. In determining chimney capacity the only satisfactory basis is the fuel burned.

Chimneys proportioned by the table will be large enough to bear crowding considerably above the rating given; this should always be provided for, as circumstances are always likely to arrive that will require a little crowding; in fact, extra capacity is always required when fresh coal is supplied to the furnace.

While it will be seen that a moderate low chimney of larger diameter may be made to do the work of a higher chimney, generally speaking it will not do it with so good economy, because the loss due to getting the air through the grate will call for higher temperature in the low chimney, which means that more heat is going to waste.

The *Practical Engineer* says: "A compound engine that will perform the same work as a simple engine must have the large cylinder nearly equal in capacity to the cylinder of the simple engine." There is lots of fallacy in this, by implication. The low pressure cylinder of a compound engine should always be larger than the cylinder of a simple engine, otherwise the same work will not be done by equal expansion. As one object of compounding is to bring about more expansion than can be economically accomplished in a single cylinder, the low pressure cylinder of a compound engine should always be considerably larger than the cylinder of a simple engine.

A reputation for safety is a great thing, even in these times when almost everything gives way to speed. This is very satisfactorily exemplified in the instance of the Cunard steamship Scythia. The captain of this vessel, instead of trying to keep up the record for time by driving ahead into Boston harbor during a tremendous gale, put about, and got sea room for safety. Perhaps he lengthened his trip by doing so; but there are a good many who will be glad to cross the Atlantic with him on account of this precaution. In the meantime those who believed that the Scythia would keep on her course, and who predicted shipwreck on this assumption, were badly left. All credit to the captain of the Scythia; he knew his business.

CHIMNEY PROPORTIONS.

H = height of chimney, in feet; D = diameter of chimney, round or square, in inches; P = pounds of coal that can be burned per hour.

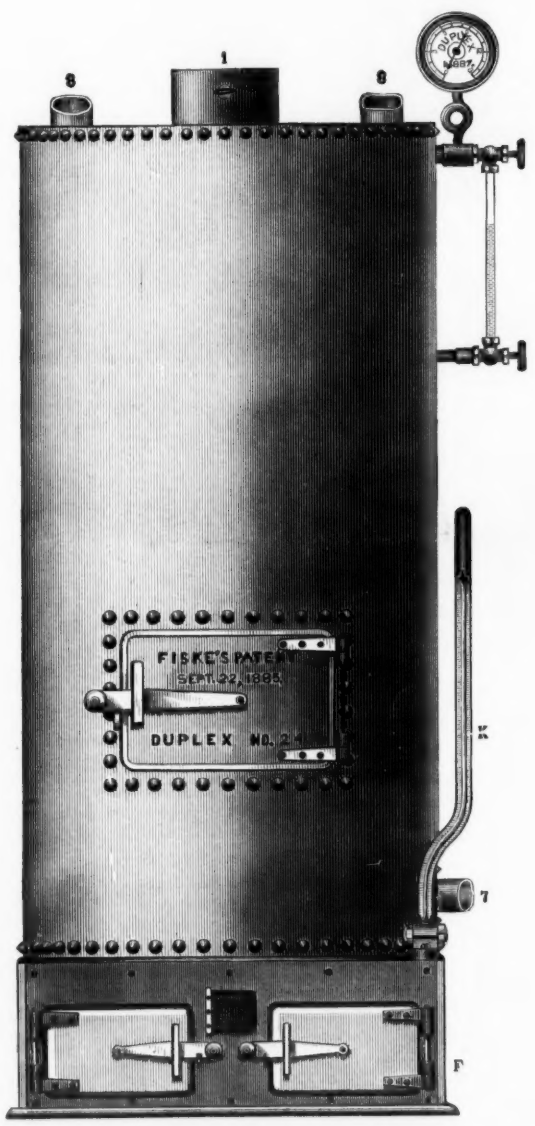
	H. 40		H. 60		H. 80		H. 100		H. 120		H. 150	
D	Round	Square	Round	Square	Round	Square	Round	Square	Round	Square	Round	Square
	P	P	P	P	P	P	P	P	P	P	P	P
12	42	53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	72	92	84	107	.....	.....	.....	.....	.....	.....	.....	.....
18	110	138	128	164	143	180	.....	.....	.....	.....	.....	.....
21	155	198	184	226	205	264	.....	.....	.....	.....	.....	.....
24	210	270	246	313	280	355	302	385	.....	.....	.....	.....
27	.....	.....	326	414	365	465	396	500	420	535	.....	.....
30	.....	.....	431	548	465	594	505	645	535	680	560	712
33	.....	.....	515	660	580	740	626	800	666	845	700	890
36	.....	.....	620	812	700	890	752	960	812	1036	858	1090
42	.....	.....	.....	.....	990	1260	1075	1366	1155	1470	1230	1565
48	.....	.....	.....	.....	1330	1696	1450	1850	1550	1980	1660	2120
60	.....	.....	.....	.....	.....	.....	2375	3020	2560	3260	2740	3485
72	.....	.....	.....	.....	.....	.....	.....	.....	3800	4840	4060	5170

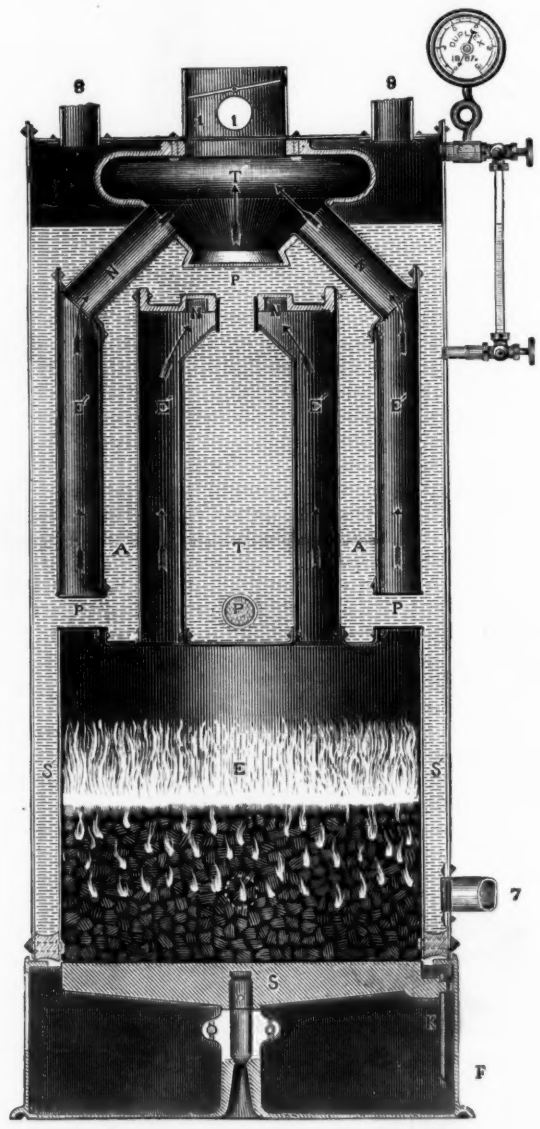
Improvement in Steam Boilers.

The two views shown above illustrate clearly what is considered an improvement in vertical or upright steam boilers. The sectional elevation shows an ample furnace, with a sufficient space for combustion above the bed of fuel, to insure a thorough mingling and burning of the gases, thereby producing the maximum temperature obtainable from the fuel used. From the top of the furnace, the heat passes into vertical annular flues, which subdivide and surround the water spaces *A*, *T* and *S*. These annular flues are connected by cylindrical flues *N* with the superheater *T*, through which all the heat not otherwise absorbed must pass. The outer surface of the superheater is ribbed to obtain a large amount of extended heating surface (not shown in cut) and nearly doubling its capacity. The smoke pipe connection *I*, leading to chimney, is fitted with a circular draft check through which the flues *N* can be easily cleaned.

The grate *S* is circular in form, and cast in one piece, excepting a hinged section, which can be dumped. The grate is supported by a strong pin at the center, and is shaken with great ease by the lever *K*. The square base is of neat appearance. The front plate to which the ash doors are fitted, is removable, to admit of changing the grate without disturbing the boiler. The water connections *P* connect the water spaces *S*, *A* and *T* at the bottom, and as each space is open at the top, a perfect and active circulation is obtained.

This boiler is made by Samuel Fiske, 110 Barclay street, New York city.





The Use of Graphite.

W. H. Linnett writes us:

"If engineers, machinists and millwrights in general, and pipe-fitters in particular, knew half the good qualities of graphite, I dare say there would be ten times the demand there is for it. Its lubricating qualities are questioned only by the impractical, and it is this quality alone that sounds its keynote, so to speak. The uses to which I have applied it would take more space to describe than I feel disposed to ask, and will therefore describe a few of what I consider most important. As before stated, its primary object is lubrication, and to this fact we must credit good pipe joints and cool bearings that would otherwise warm up. In mixing it to make pipe cement (or, as I would term it, pipe smear), the necessity of using boiled oil is highly questionable, as the drippings from bearings, or any other no-good-for-anything-else oil, answer the same purpose; it is the graphite and not the body in which it is suspended that makes the joint. I use the drippings from line shaft bearings caught in the ordinary way, and simply mix in graphite enough, so that it can be nicely applied with an ordinary sash tool.

During the past three years I have used in the neighborhood of fifteen or twenty pounds of dry American graphite for piping, joints, cylinder heads, piston-rod packing, etc.

Bolts smeared with graphite mixed as above, I have unscrewed after having been in the dampest places for upwards of two years or more, proving its anti-rusting qualities. To cool a hot bearing, put it on as thick as it will mix with oil.

I should like to hear how to use it for lubricating steam cylinders, if anyone is so doing, together with their experience."

A paper on "Problems in Mechanism Regarding Trains of Pulleys and Drums of Least Weight for a given Velocity Ratio," was recently read by Professor H. Hennessy, F.R.S., before the Royal Society. As trains of wheels, pulleys, and drums are frequently employed in machinery for the transformation of large and small velocities of rotation, it appeared desirable to inquire into the conditions which would favor the greatest economy of weight of the parts forming such trains. Eighty years since Dr. Thomas Young had arrived at a theorem for the minimum number of teeth in a train of wheels and pinions with a given velocity ratio, and when the pairs of wheels and pinions are similar. By investigating the question of minimum volume or minimum weight of trains the author has been led to the following results, which are fully demonstrated in his paper, namely, that for a train of cylindrical pulleys composed of similar pairs, the ratio of the diameter of a large to that of a small pulley should be as 19 to 10. For drums composed of hoops supported by disks of the same thickness, and with the breadth of each hoop equal to the radius of the small drum, the ratio of the diameters should be 11 to 5. If the hoop was supported by spokes whose volume taken together would be half the volume of a complete disk, the ratio would be 51 to 20. With regard to a train of pulleys, it was shown that a single pair possessing the same velocity ratio as a series with the ratio of diameters found for minimum volume, the latter would be considerably less than the former. Thus, with five pairs whose velocity ratio would be nearly $24\frac{3}{4}$, the volume would be less than the $\frac{1}{8}$ of a single pair possessing the same velocity ratio. A model constructed in brass of such a train, with all the large pulleys 1.9 inches in diameter, and all the small 1 inch, weighed 18.34 ounces. A train of four pairs of drums illustrative of the last problem solved weighed 16.788 ounces, the large drums being 2.55 inches, and the small 1 inch diameter, while all the hoops were $\frac{1}{2}$ inch broad. The velocity ratio of this train is 42.2825, or a little more than $42\frac{1}{4}$.—*The Engineer.*

The new locomotives on the Pennsylvania Railroad weigh sixty tons, and will pull forty-five loaded freight cars. The company has been, for some time, strengthening the bridges, to make them safe for the extra heavy traffic.

Suggestions in Machine Design.

A. J. Shaw.

SEVENTH PAPER.

Be distrustful of the thing that is sure to work; it only too often will not work.

Nothing is as uncertain as the affirmation of experience—except the denial of experience.

A's statement that a certain device is good for nothing, is not necessarily conclusive as regards B, to whose wants the article in question may be perfectly adapted; a slight change of conditions making that which was worthless to one of value to the other.

When we hear it said that "theory" and "practice" are incompatible, we are usually safe in assuming that the speaker knows nothing about theory, and possibly very little about practice.

Either the theory may be incorrect or the practice may be bad, in which case they may or may not agree; but when both are correct they must and will concur.

It often happens that the disagreement is only an apparent one, and seems to exist because some of the conditions of the case have been overlooked.

Only that theory can be correct which includes all the conditions.

Experience is the gauge by which must be tested all theory, as its agreement with true theory is the final measure of the correctness of practice.

The failure of empirical formulæ is often due to the attempt to force their application beyond the limits beyond which they are in accordance with the conditions; outside of which limits they must necessarily be inadequate.

"Rules of thumb" are admissible only when no others are attainable. They almost never include even all the important conditions, and are unreliable in proportion.

To put a great conception into practicable shape is only less difficult than to originate it.

It sometimes happens that the invention is really made by him who works up the original conception, which is so hazily indistinct in the inventor's mind that it is less difficult to devise methods of doing that which he wishes to accomplish than to discover what his ideas actually are.

In adapting attachments or new devices to existing machines, it is desirable so to form and arrange the parts as to avoid, as far as possible, an appearance of patchiness.

The aim should be so to harmonize the new and the old that they may seem cotemporaneous, or, at least, may convey the impression that the one is an outgrowth of the other, rather than that they are the distinct creations of different epochs.

This can usually be attained by a little care and study.

When ends of shafts, motion screws, etc., are squared to fit removable cranks, do not cut the outer end square across or with only a slight round as at *A*, Fig. 7, but finish with a long chamfer, as shown at *B*. The end of the chamfer may be hemispherical, or may terminate in a flat, the diameter of which is less than the short diameter of the square.

This is a great convenience in putting on the crank, as it is not necessary to adjust it to an exact angular position before the end of the shaft will enter the eye.

This construction is equally convenient as applied to the squared ends of set screws, etc., which are manipulated with a box wrench, especially if they are not easily reached.

As an alternative construction, the end of the crank may be provided with a countersink, the diameter of which should slightly exceed the diameter across the corners of the square.

For shaft ends, the style of finish shown at *A*, Fig. 8, is less expensive than that shown at *B*; and if hubs are to have flat ends and round corners, it better preserves the unity of the design. Not only is it cheaper to make in itself, but as it obviates any necessity for exactness in the length of the shaft, it costs less to fit up.

For shafts projecting through unfinished surfaces, the finish shown at *A* should be used in all cases, for as it will be impossible to make the angle of the finish, *B*, coincide with the rough surface throughout its entire circumference, its appearance will be anything but satisfactory.

Stud bolts are usually made of the same diameter throughout their entire length.

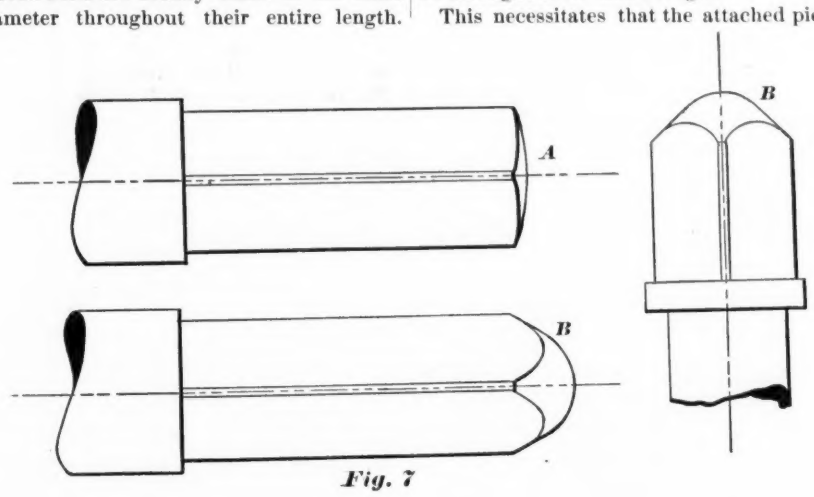


Fig. 7

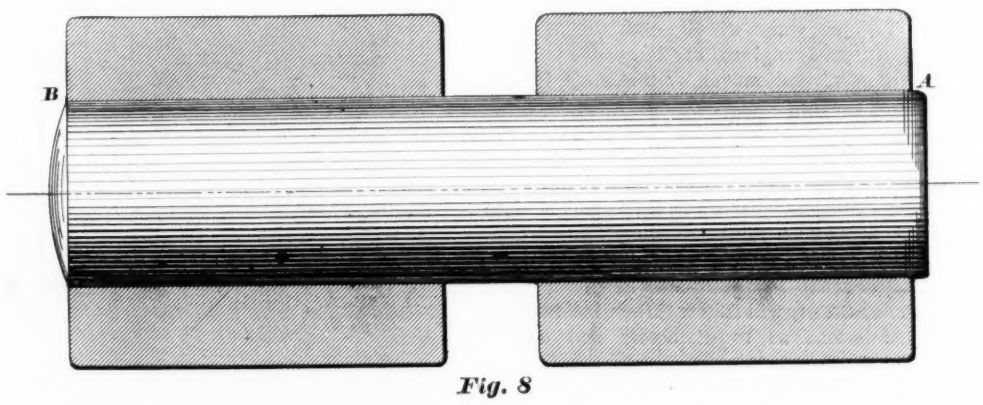


Fig. 8

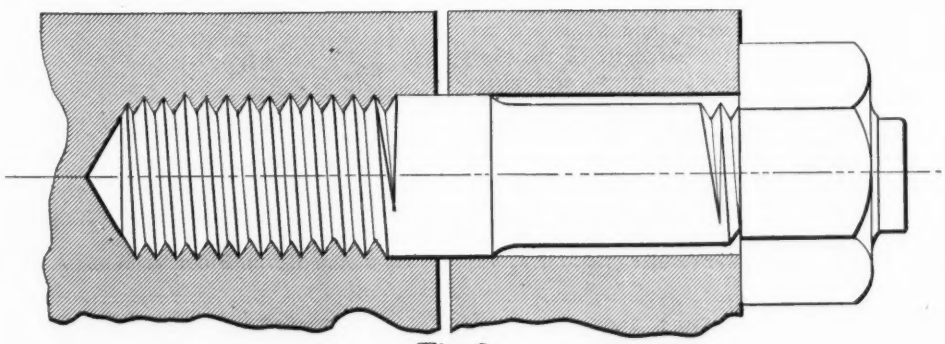


Fig. 9

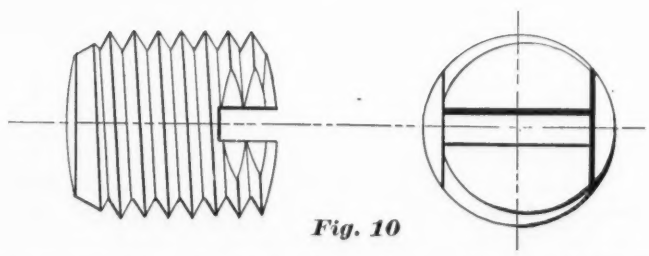


Fig. 10

When they are required to act as dowels or are "fitted bolts," they present some disadvantages which may be obviated by a slight change in the form of the bolt.

An improved construction is shown in Fig. 9. It has the advantages of greater strength, of greater convenience in removing and replacing the attached piece, and of greater accuracy of fit.

It has greater strength, in that it is strongest where the common form is weakest—at the joint face.

As usually made the thread, on stud bolts, ends at the surface of the piece into which it is screwed, thus bringing together the weakened part of the stud and the dangerous section. It is a matter of common observation that stud bolts nearly always fail by breaking or twisting off at this point.

The common form of stud bolt may be considerably strengthened by counterboring so as to bring the termination of the thread below the surface, but even then, that remains the weakest point.

The improved form of the bolt is enlarged at its insertion into the standing piece, the enlarged body being counterbored from one-quarter to one-half its diameter below, and projecting the same distance above the joint face. It is then reduced to the size of the thread upon which the nut is screwed.

In the common form of stud bolt, the "fit," if the bolt is "fitted," is supposed to be throughout its entire length.

This necessitates that the attached piece, when removed, must be drawn on the "fit" the whole length of the bolt, including the thread; while if the piece be secured by two or more bolts, if any one of them deviates from exact parallelism, it must be sprung or bent before the piece can be removed.

In the improved form, as the length of the fit is not greater than one-half the diameter of the bolt, a slight deviation from parallelism has little influence on the character of the fit, and it is necessary to move the attached piece through but a short distance before it is entirely free; nor is there danger of injuring the thread by dragging the piece over it.

As there is no "fit" on the reduced part of the body, any slight injury at that point is of little consequence, so that a dog or even a pipe wrench may be used to advantage in screwing the bolt into its place, thus avoiding any danger of stretching the thread by the use of double or cap nuts.

Whatever form of bolt is used, the screw thread should not terminate at the joint, especially if the bolt is in shear. The "doweling" should be done by the body of the bolt, and not by the threaded portion.

The thread on headless set-screws should not be carried the whole length, when it can be avoided, but should terminate below the screw-driver slot. If the threads cross the slot, they are likely to be more or less injured by the screw-driver. When it is not practicable to limit the length of the thread, the same end may be attained by flattening the screw at the sides, as shown in Fig. 10, which needs no explanation.

Cab Windows.

By John A. Hill.

In all the locomotives I have ever seen there are small windows in the front of cab over boiler, besides the front doors. These are big or little, according to the amount of room that the class of engine will allow. These windows always slide—because the first one ever made did, I suppose. They are held by and slide in an angle piece of wood, screwed inside the cab. Now, this groove always catches cinders and other dirt, and the sash being loose soon wears small, then it rattles and is always working open when you want it shut, and *vice-versa*. In hot weather, when men are rustling for every breath of air there is, it is a great help to open these holes; but where engines work hard the shower of cinders more than offsets the little air, and when the engine is second on a double-header, the cinders and sore eyes and burning waste are magnified several times, the rains and snows beat against the glass, run down into the groove, and, pregnant with cinders and dust, on the boiler head and bright work. All this may not appear to amount to very much, but, like a thousand other little things on a locomotive, they aid in the main object, and are comforts or nuisances, and where they can be improved at no expense I say improve.

I think if the sash was placed on the outside of cab, with a strip just as thick above it, to which it was securely hinged so that it would open outwardly, it would cure the trouble. To the bottom of this sash, inside, should be secured a light rod running on an angle up to the roof, and fitted with a head, carrying set screw sliding on a bar, like the door on a Baldwin engine. With this arrangement the window could be kept securely fastened, shut or open, any distance, and no rattle; the glass would act as an awning, keeping out cinders, rain and snow, that would be obliged to drip outside instead of inside; inside the cab would be plain and easier kept clean; no need of screens, and the crew would have air, comfort and scenery—minus dirt.

"The New South: Its Resources and Attractions" is the title of a handsomely bound volume of over 400 pages, published by the *Manufacturers' Record* Co., of Baltimore. It gives in detail the characteristic features of each of the Southern States, especially as regards the manufacturing and mining resources and advantages. The material for the work has been collected with great care, and is up to date. Those who wish reliable information about the South as it is now should get a copy of the book. It is sold at $2.50 bound in cloth, and $3.00 bound in Russia leather.

Moulding Bevel Friction Wheels.

By Geo. O. Vair.

The accompanying cuts represent a plan for moulding or sweeping up a bevel friction, the pattern-work for which can be made in a very short time compared with that required to make an entire pattern. The advantage of sweeping up such wheels is the saving of making a full pattern, and full rim patterns for wheels of this description are very apt to warp and get out of true, thereby causing uneven thickness in the rim of casting after it has been turned in the lathe.

We have been making our small-size bevel friction wheels from 12″ to 30″ by the plan here shown for the past year, and find it satisfactory, both as to speed in moulding and true castings.

In moulding wheels in this way, a full set of arm patterns are required. After bedding in the arms, the sweep *A*, Fig. 2, is attached and held in place by a wood screw; after sweeping on the thickness of sand, as seen at *B*, Fig. 2, the sweep is removed, and the cope rammed up and lifted off. After fastening piece *C*, Fig. 1, on with screws, the sweep is returned, and the thickness of rim is swept out, as at *D*, Fig. 1. The arms are then drawn out, and the mould is finished up in the usual manner. The bead at *E*, Fig. 1, is to strengthen the rim when so desired. Fig. 3 is plan of sweep, so shaped to give a good bearing on hub of wheel pattern when being used. Fig. 4 is a top view of wheel.

In moulding larger sizes of those wheels, we cast them face down, use full arm patterns, and sweep the rim out with a sweep secured to a spindle.

The plan here shown of making these wheels was first suggested to me by one of our patternmakers, and is, as far as I know, original.

An exchange says: A fire broke out near the Government wharf in Detroit, and the officer in charge called a tug, which put out the fire. The bill was sent to Washington, and payment refused because the officer did not advertise for sealed proposals to put out the fire and have it done by the lowest bidder.

Shafting and Its Strength Under Various Methods of Transmission.

By W. H. Hoffman.

In a paper read before the Mechanics' Institute of Minneapolis, by Mr. C. L. Redfield, I note that this engineer, like many others of the fraternity, desires to simplify the rules relating to the ordinary practice in engineering, where power and the strength of materials are under consideration.

Mr. Redfield has certainly an excellent object in view, viz.: the removing of many clouds of mystery from the vision of the young engineer and student, as well as the factory or mill owner. The paper presented to the institute by Mr. Redfield is worthy of much praise, but there is one matter mentioned by him, that requires further explanation. There can certainly be no better explanation of the term one horse-power, than the old and simple statement that 33,000 pounds raised one foot high in one minute, represents that energy, and the matter of power by shafting, used as first and second movers, or, in other words, water-wheel, engine, and line shafts, is capable of being solved, by a rule as simple as the horse-power constants.

Mr. Redfield says: "If we take this form of expression as a type, and apply it to a shaft, we will find that a 1-inch shaft at 100 revolutions will transmit one horse-power." Now of course we understand that Mr. Redfield used these figures as a matter of illustration only, and not as a fact; so just here I must beg to offer a mild protest.

From a long and continuous practice of the cotton, woolen and silk mills in the Eastern and Middle States, under the heaviest kinds of transmission, there have been many formulas adopted for the safe working sizes of all kinds of shafting. Shafts to be first considered, are the prime movers, operated by steam or water, and known as the engine or water-wheel shafts. Next in order, we have the second movers, or line and jack shafts.

My rule for first movers, or engine shafts, fitted with a single crank, is that a one-inch shaft should transmit .004 of one horse-power for each revolution per minute, and that a one-inch crank-shaft will transmit .007 of one horse-power for each revolution, where there is a crank on each end, placed at right angles.

A second mover or line shaft, however, $\frac{15}{16}$ of an inch in diameter, will transmit from .015 to .020 horse-power for each revolution per minute, according to conditions. That is to say, a $\frac{15}{16}$ line shaft, put up properly, will transmit easily two horse-power at 100 revolutions per minute, and a $1\frac{15}{16}$ line shaft is good for 16 horse-power, and there are hundreds of them doing this, and even much higher service.

The following tables have been the practice of the writer for factory line shafts for many years, and nearly all cases, using the ordinary commercial round iron, turned down $\frac{1}{16}$ of an inch for standard size.

Where the engine or first moving shafts are speeded from 40 to 60 revolutions, the stress and torsion, on the line shafting, is much more irregular than where the first movers run from 100 to 160 revolutions per minute, hence the necessity of two tables for line shafting.

Turbine water-wheels and the modern high speed engines, are less liable to fracture a second mover or line shaft, than a slow moving motor, and as I am satisfied from my experience that this statement is correct, I feel that it would have been best for Mr. Redfield to have started out with the statement that a one-inch shaft at 100 revolutions per minute would transmit two horse-power; then of course the rule that the power to transmit varies as the cube of the diameter, will follow through all further calculations as to diameters and horse-powers.

In the table for engine shafts, I have calculated them as ordinary forged shafts of wrought iron, though I prefer steel for this service, and where that material is used the strength of the shaft should be at least twenty per cent. above the figures in the tables. It is well known that Krupp, of Germany, has made many shafts of steel for steamships running to this port, from 20 to 22 inches in diameter, that at an average speed of 68 revolutions per minute, are transmitting from 9,000 to 11,000 horse-power under very irregular loads, that sometimes vary 50 per cent. in one minute. These shafts are fitted with three cranks, which raises the factor of strength, according to the subdivision of the circle at 120°.

Average Cutter Speed and Feed on Soft Cast Iron Surfaces.

(From E. E. Garvin & Co.'s recent catalogue.)

These figures are adapted to calculations in milling upon soft cast-iron surfaces, and are subject to change to accompany variations in condition and character of work. In order to figure accurately upon milling work, the speed of cutter and amount of feed per revolution must be observed—that known, the computation is simple, as follows: Multiply the number of revolutions of cutter per minute by the length of feed at one revolution, and the product is inches per minute that can be milled. Allowing about 40 ft. per minute for surface speed of cutter, a $\frac{1}{2}$ in. cutter should run at 300 revolutions per minute with a feed of $\frac{1}{150}$ of an inch to a revolution, giving a result of 2 inches of light milling per minute. An inch cutter would make 150 revolutions per minute, with a feed of $\frac{1}{100}$ of an inch on a moderately heavy cut, allowing $1\frac{1}{2}$ inches of milling per minute. A 3-in. cutter would run 50 revolutions per minute, with a feed of $\frac{1}{50}$ of an inch on heavy work, giving a result of 1 in. of milling per minute. The above are examples selected from observed results in practical shop usage.

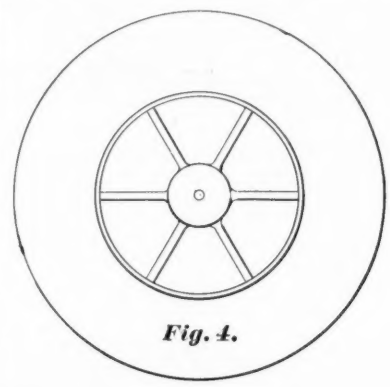


Fig. 4.

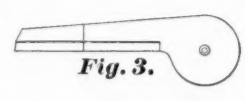


Fig. 3.

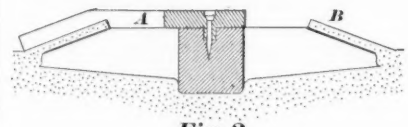


Fig. 2.

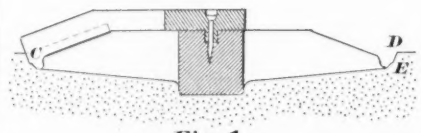


Fig. 1.

Moulding Bevel Friction Wheels.

Table No. 1. Line.		Table No. 2. Line.	
Diameter of Shaft in Inches.	Indicated Horse-Power for Each Rev. per Minute.	Diameter of Shaft in Inches.	Indicated Horse-Power for Each Rev. per Minute.
Wrought Iron.	Engine Speeded from 40 to 60 Rev.	Wrought Iron.	Engine Speeded from 100 to 160 Rev.
$\frac{15}{16}$	.013	$\frac{15}{16}$	.020
$1\frac{3}{16}$	.024	$1\frac{3}{16}$	.030
$1\frac{7}{16}$	043	$1\frac{7}{16}$	.067
$1\frac{11}{16}$	.068	$1\frac{11}{16}$	.108
$1\frac{15}{16}$	.104	$1\frac{15}{16}$	.160
$2\frac{7}{16}$	.168	$2\frac{7}{16}$	.280
$2\frac{15}{16}$	.344	$2\frac{15}{16}$	.531
$3\frac{7}{16}$	.548	$3\frac{7}{16}$	.810
$3\frac{15}{16}$	.832	$3\frac{15}{16}$	1.280
$4\frac{7}{16}$	1.164	$4\frac{7}{16}$	1.692
$4\frac{15}{16}$	1.344	$4\frac{15}{16}$	2.242
$5\frac{7}{16}$	2.124	$5\frac{7}{16}$	3.283
$5\frac{15}{16}$	2.752	$5\frac{15}{16}$	4.248
$6\frac{1}{2}$	3.512	$6\frac{1}{2}$	5.492
$7\frac{1}{2}$	4.390	$7\frac{1}{2}$	6.480
$8\frac{1}{2}$	6.713	$8\frac{1}{2}$	10.240
Diameter.	Engine Shafts with Single Crank, Horse-Power.	Diameter.	Engine Shafts, Two Cranks, at Right Angles, Horse-Power.
2″	.032	2″	.056
4″	.256	4″	.448
8″	2.048	8″	3.584
16″	16.384	16″	28.672

Hangers spaced from 8 to 13 feet apart according to the diameter of shafts and number and weight of pulleys and belts.

Testing Virginia Irons.

By Robert E. Masters.

In December, 1885, the editor of the *Western Manufacturer* wrote me the demand for an article on mixtures of metals copied from December 5th, 1885, issue of the American Machinist had exhausted the edition. Tests of the above mixtures containing a per cent. of steel, wrought and malleable iron were made for the writer at the Wisconsin State University.

In April 24th, 1886, issue of the American Machinist an article on the strength of leading brands of Pennsylvania, Ohio and Wisconsin irons, and illustrating an arrangement for testing irons in the foundry, which had appeared in a previous issue, had to be reprinted to supply the demand. An appliance for testing iron similar to the arrangement spoken of has since been attached by some scale manufacturers to scales offered for foundry use. While it is not a common occurrence for an article to be so attractive as to exhaust the edition of a mechanical or scientific journal, we do not speak of these two instances to compliment ourselves, but simply to show from the above facts that foundrymen have more of a disposition to know the strength of their irons instead of making up a mixture and "guess it is about right."

At the Tredegar iron works during the past season we have been making tests of the leading brands of Virginia irons on a different plan from any that have been conducted heretofore. First we tested each brand alone (without the mixture of any other pig iron or scrap with it) for transverse breaking pressure, shrinkage and depth of chill. All test bars for breaking pressure were 1″ square, 30″ long, and 24″ between points of bearing when pressure was applied. The bars were cast horizontal and poured with bright fluid iron in green sand. The tests for depth of chill were made on pieces $4″ \times 4″ \times 1\frac{1}{2}″$ cast open with one side of the 4″ face against a clean, dry, cold chill $3\frac{1}{2}″$ thick. The following are the results of the first series of tests:

Test No. 1.

Brand "Speedwell."

Transverse pressure.....1,097 pounds.
Depth of chill.....$\frac{5}{16}$″
Shrinkage.....$\frac{5}{16}$″ in 30″

Test No. 2.

Brand "Foster Falls" or "Pierce."

Transverse pressure.....950 pounds.
Depth of chill.....$\frac{3}{4}$″
Shrinkage.....$\frac{3}{8}$″ in 30″

Test No. 3.

Brand "Ivanhoe."

Transverse pressure.....972 pounds.
Depth of chill.....$\frac{1}{2}$″
Shrinkage.....$\frac{3}{8}$″ in 30″

Test No. 4.

Brand "Liberty."

Transverse pressure.....1,121 pounds.
Depth of chill.....$\frac{3}{16}$″
Shrinkage.....$\frac{5}{16}$″ in 30″

Test No. 5.

Brand "Lynchburg."

Transverse pressure.....890 pounds.
Depth of chill.....$\frac{5}{16}$″
Shrinkage.....$\frac{1}{4}$″ in 30″

Test No. 6.

Brand "Crozer."

Transverse pressure.....820 pounds.
Depth of chill.....none.
Shrinkage.....$\frac{5}{16}$″ in 30″

Test No. 7.

Brand "Princess."

Transverse pressure.....1,002 pounds.
Depth of chill.....none.
Shrinkage.....$\frac{7}{32}$″ in 30″

Test No. 8.

Brand "Low-Moor."

Transverse pressure.....963 pounds.
Depth of chill.....none.
Shrinkage.....$\frac{3}{16}$″ in 30″

The Speedwell, Pierce, Ivanhoe and Liberty are cold blast, charcoal irons from red and brown hematite ores. The Lynchburg, Crozer, Princess and Low-Moor brands are hot blast, coke irons. The Crozer and Low-Moor are from local brown hematite ores, the Lynchburg from brown hematite and magnetic, and the ores that produce the Princess brand are hematites and maganese mined on the furnace property.

It will be noticed that all the tests for transverse pressure in the coke (soft) irons, with the exception of the Princess brand, are below the pressure attained from the charcoal (hard) irons, the Princess standing a higher pressure than the Pierce or Ivanhoe. These tests were made of irons selected from No. 1 of all the brands used. The first four are irons manufactured especially for car wheels, and the last four for foundry pig iron. We concluded to carry our experiments further and learn what the result would be from mixing them with each other, using 50 per cent. of Speedwell, which gave the medium result of the charcoal irons as a base to work from.

Test No. 9.

Speedwell.....50 per cent.
Foster Falls or Pierce.....50 "
Transverse pressure.....984 pounds.
Compression.....73,040 "
Depth of chill.....$\frac{5}{8}$"

Test No. 10.

Speedwell.....50 per cent.
Ivanhoe.....50 "
Transverse pressure.....1,021 pounds.
Compression.....84,380 "
Depth of chill.....$\frac{3}{8}$"

Test No. 11.

Speedwell.....50 per cent.
Liberty.....50 "
Transverse pressure.....1,167 pounds.
Compression.....90,300 "
Depth of chill.....$\frac{5}{16}$"

Test No. 12.

Speedwell.....50 per cent.
Lynchburg.....50 "
Transverse pressure.....1,297 pounds.
Compression.....95,400 "
Depth of chill.....$\frac{1}{2}$"

Test No. 13.

Speedwell.....50 per cent.
Crozer.....50 "
Transverse pressure.....1,122 pounds.
Compression.....91,800 "
Depth of chill.....$\frac{3}{16}$"

Test No. 14.

Speedwell.....50 per cent.
Princess.....50 "
Transverse pressure.....1,452 pounds.
Compression.....107,120 "
Depth of chill.....$\frac{1}{16}$"

Test No. 15.

Speedwell.....50 per cent.
Low-Moor.....50 "
Transverse pressure.....1,614 pounds.
Compression.....120,200 "
Depth of chill.....none.

The shrinkage in this second series of tests is not given, the only change being the soft irons counteract the shrinkage of the hard irons to a considerable extent. In tests Nos. 9, 10, and 11, where the charcoal irons are melted together, there is a slight increase in the transverse breaking load above that obtained in melting them alone; but in Nos. 12, 13, 14, and 15, a very decided difference is seen by the mixing of the charcoal and coke irons. Tests Nos. 14 and 15 show a higher transverse breaking strain than any recorded or published test that we know of. The tests for compression were made on bars 1" square, 2" long, by Mr. George D. Harris, superintendent motive power Mobile and Ohio Railroad, and Mr. Wm. Hasman, master mechanic of the Richmond and Alleghany Railroad.

It is claimed by some that the strongest castings are made from iron poured at a dull heat. Our practice and experiments show us the reverse of this theory is the most effective, and that the best results have been obtained from metal poured hot has been plainly demonstrated by Mr. Gardener, superintendent of The Pratt and Whitney Foundry, Hartford, Conn., and by Thos. D. West, on an Olsen machine at the Otis Steel Works, Cleveland, Ohio. See pages 8 and 9, "Moulder's Text Book."

Practical Drawing.

By J. G. A. Meyer.

TWENTY-SECOND PAPER.

Problem 36.

204. TO CONSTRUCT A NUMBER OF REGULAR POLYGONS ON A GIVEN LINE AS A SIDE.

Fig. 154. Let $H\ G$ be the given line; it is required to construct on this line the following regular polygons, namely, a polygon having 6 sides, 7, 8, 9, 10, 11, and 12 sides.

In Art. 203 we have shown how polygons of any number of sides can be constructed separately on a given line as a side. But the following method is well adapted to the construction of these particular polygons; and more so, when all these polygons have to be constructed on one and the same line as a side. Indeed, in some instances, the method here employed may be preferable in constructing these polygons separately to that employed in Art. 203; and, besides this, to draw all these polygons on one line as a side will give the student excellent practice in drawing, since great accuracy is necessary to draw these correctly: The student should first draw this figure on a separate piece of paper, and after he can construct this figure correctly, it should be drawn on the regular sheet. Bisect the given line $H\ G$ by the perpendicular $I\ K$ (Art. 110). From the point H as a center, and with a radius equal to the given line $H\ G$, describe an arc $A\ G$ cutting the perpendicular $I\ K$ at the point A. Divide the arc $A\ G$ into six equal parts, and mark the points of division B, C, D, E, and F. From the point A as a center draw an arc which will pass through the point B, and cutting the perpendicular $I\ K$ in the point 7. From the same center A draw arcs which will pass through the points C, D, E, and F, cutting the perpendicular at the points 8, 9, 10, and 11; also from the center A draw a circle whose circumference will pass through the ends H and G of the given line $H\ G$, and cutting the perpendicular $I\ K$ at the point 12. This circle will be the circumscribed circle of a regular polygon having 6 sides each equal to the given line $H\ G$ (Art. 190); consequently by laying off in this circle a number of chords in succession each equal to the given line $H\ G$, the polygon of 6 sides will be completed. From the points 7, 8, 9, 10, 11, and 12, as centers, describe circles whose circumferences will pass through the points H and G. These circles will be the circumscribed circles of regular polygons having 7, 8, etc., sides; consequently, to finish the figure, lay off in the circle drawn from the center 7 a number of chords each equal to the given line $H\ G$; if correctly drawn this circle will contain the given line seven times as a chord; the next circle drawn from the center marked 8 will contain the given line eight times as a chord, and similar remarks apply to the other circles.

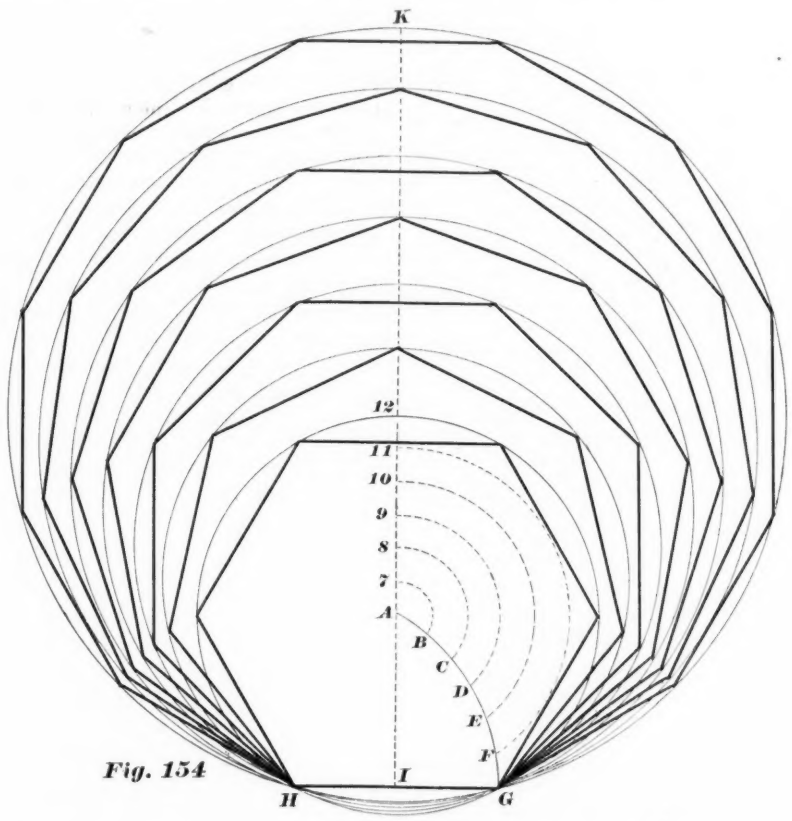


Fig. 154

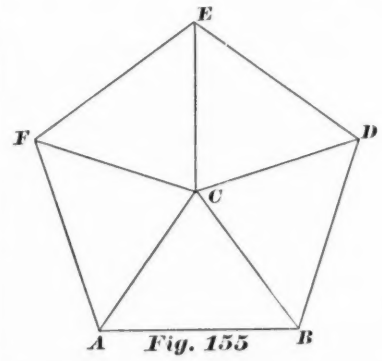


Fig. 155

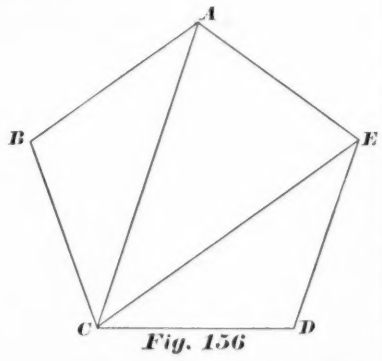


Fig. 156

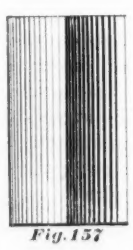


Fig. 157

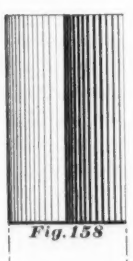


Fig. 158

Fig. 158a

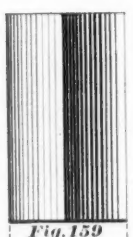


Fig. 159

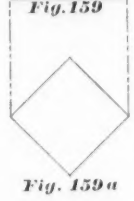


Fig. 159a

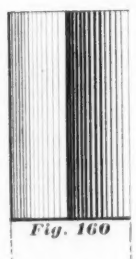


Fig. 160

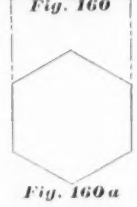


Fig. 160a

Fig. 161

Fig. 161a

205. NAMES OF POLYGONS.

A polygon having 3 sides is called a triangle.
" " 4 " " quadrilateral.
" " 5 " " pentagon.
" " 6 " " hexagon.
" " 7 " " heptagon.
" " 8 " " octagon.
" " 9 " " nonagon.
" " 10 " " decagon.
" " 11 " " undecagon.
" " 12 " " dodecagon.

206. TABLE SHOWING THE NUMBER OF DEGREES CONTAINED IN ONE ANGLE AT THE CENTER, AND THE NUMBER OF DEGREES CONTAINED IN ONE INTERIOR ANGLE OF THE POLYGON.

Regular Polygons.	Number of Degrees in the Angle at the Center.	Number of Degrees in the Interior Angle of the Polygon.
Polygon having 3 sides.	120°	60°
" " 4 "	90°	90°
" " 5 "	72°	108°
" " 6 "	60°	120°
" " 7 "	51 3-7°	128 4-7°
" " 8 "	45°	135°
" " 9 "	40°	140°
" " 10 "	36°	144°
" " 11 "	32 8-11°	147 3-11°
" " 12 "	30°	150°

The number of degrees contained in the angle at the center, as given in the table, have been obtained according to the method given in Article 180; that is, we divide 360 degrees by the number of sides of the polygon; the quotient will be the number of degrees contained in the angle at the center, or the angle formed by the two lines drawn from the center of the polygon to the extremities of one side of the polygon. The number of degrees contained in the interior angle of the polygon, or simply the "angle of the polygon"—that is, the angle formed by any two adjacent sides of the polygon—have been found in the following simple manner: Let $A\ B\ E$, Fig. 155, represent a regular polygon; from the center C draw straight lines, as $C\ D$, $C\ E$, $C\ F$, etc., to the extremities of the sides; these lines will divide the polygon into as many equal triangles as the polygon has sides. It must be evident that the lines $C\ D$, $C\ E$, etc., will bisect the angles of the polygon; thus for instance the line $C\ E$ will bisect the angle $F\ E\ D$, and consequently the sum of the angles $C\ F\ E$ and $C\ E\ F$, of the triangle $F\ E\ C$, must be equal to angle of the polygon $F\ E\ D$. But the sum of the angles in all triangles is equal to 180 degrees (Art. 117), and since we know the number of degrees contained in the angle at the center, it follows that by subtracting the number of degrees in the angle at the center from 180 degrees, the remainder will be the number of degrees contained in any one of the interior angles of the polygon. Thus, in the figure before us, the angle at the center will contain $360 \div 5 = 72$ degrees; and $180 - 72 = 108$ degrees = the number of degrees in any one of the interior angles of the polygon.

207. In geometry a different course of reasoning is adopted for determining the number of degrees contained in an interior angle of a polygon. Thus: Fig. 156. Let $A\ B\ C\ D\ E$ represent any polygon: it is to be proved that the sum of the interior angles A, B, C, D, and E is equal to two right angles taken as many times as the polygon has sides, less two.

From the vertex of any angle, as C for instance, draw the diagonals $C\ A$ and $C\ E$. The polygon will then be divided into as many triangles, less two, as it has sides, having the point C for a common vertex, and for bases, the sides of the polygon, except the two which form the angle C. Now it must be evident that the sum of the angles of these triangles does not differ from the sum of the interior angles of the polygon, and since the sum of the angles in each tri-

angle is equal to two right angles, it follows that the sum of the interior angles of the polygon is equal to two right angles, taken as many times as there are triangles; that is, as many times as the polygon has sides, less two; which was to be proved. But when we know the sum of the interior angles of a polygon we find the number of degrees in each angle of the polygon by dividing the sum by the number of angles, or sides of the polygon. Putting this statement in the shape of a formula we have

$$\frac{\text{180 degrees} \times (\text{number of sides less two})}{\text{Number of Sides}} = \left\{\begin{array}{l}\text{Number of degrees in one interior angle of the polygon.}\end{array}\right.$$

REPRESENTATIONS OF SOLIDS.

208. We next come to that branch of practical drawing which has for its object, first, the accurate representation of all geometrical magnitudes on planes; and secondly, the construction of all graphic problems involving three dimensions. Or if we connect the idea of matter with geometrical magnitudes (Art. 18), we may say that this branch of practical drawing has for its object, first, the accurate representation of all solids on plane surfaces or paper; and secondly, the solutions of problems relating to the intersections of surfaces and solids; and the development of surfaces on planes.

209. A correct outline of any solid will be such a drawing as will at once convey to others our idea of form without any other explanation. Drawings of this kind must have at least two views of the same solid. Take for instance the representation of a solid in Fig. 157; can any one tell what kind of a solid this figure represents? No, because only one view if this solid is shown, and hence it may represent a solid whose cross-section is a triangle, a square, a hexagon, or nothing of the kind. But now notice Figs. 158 and 158 *a*; these show two views of one solid; indeed, these two views give us a complete idea of the form of the solid. Fig. 158 shows us the height and that the edges are parallel, and Fig. 158 *a* shows us the form of the ends of the same solid; and with such a drawing before us, we can shape the material with a certainty that we are correct. Again, look at Figs. 159 and 160; these appear to represent the same kind of solid as Fig. 158; but Fig. 159 *a*, underneath Fig. 159, indicates that this solid has square ends; and Fig. 160*a*, underneath Fig. 160, indicates that the ends of this solid are six-sided; and lastly, referring to Figs. 161 and 161*a*, we find that these two views call for a thin piece of material bent as shown in Fig. 161*a*. Figs. 157, 158, 159, 160 and 161 we may call elevations of the solids; and Figs. 158*a*, 159*a*, 160*a* and 161*a* we may call the plans of the same solids. Fig. 157 is of no use, as no plan is given with it. Figs. 158, 159, 160 and 161 are exactly alike; yet the plans underneath these figures show that different solids are meant. From these considerations we learn that two views of one solid are absolutely necessary in order to show its complete form. It will also soon be shown that according to the rules of geometry the plan must be placed directly underneath or above the elevation.

Engine Drivers' Eyesight.

Clement E. Stretton, in a communication to *The Engineer*, has this to say on the subject indicated by the above title, and it is common sense. Beyond this it is interesting to note what railway companies require of their servants, and the pay they give them for the necessary perfection:

"In your last issue, under the heading of 'Railway Matters,' reference is made to the testing of the eyesight of engine drivers. No one could for one moment think of allowing a man to be on an engine who could not distinguish signals, or see for any necessary distance in front of his train. Unfortunately there appears to be no standard test adopted for all railways, and on some lines the test is theoretical, and not practical. In all parts of the country meetings of engine drivers are being held and resolutions passed requesting that they may be subjected to the most careful practical tests—that is, that both by night and by day they shall be taken on the line to see signals at any required distances.

At the present time numbers of men who can see signals and go through a practical test entirely fail to tell the names of certain shades of colored wool. They are then said to be 'color blind.' But in fact this is nothing of the kind; they can see the color, but are ignorant of the name, and this ignorance causes them to be suspended from duty and reduced to some lower position at a very great loss of wages.

Unfortunately, instances have occurred and been brought to the notice of the Amalgamated Society of Railway Servants, in which the tests have been 'unfairly applied,' in order to remove certain men from their engines. This naturally has caused a very strong feeling amongst the men who suffer, and it has formed the subject of a resolution by the committee of their Society. Having been requested to reply to the paragraph referred to, I shall be much obliged if any of your correspondents will express their opinions upon what is the proper test for the eyesight of an engine driver."

LETTERS FROM PRACTICAL MEN.

About Cutting Tools.

Editor American Machinist:

I was highly pleased with Mr. F. J. Miller's article on "Cutting Tools," in your March 26th number. I have seen so many men in need of more "light" on the position of cutting edges and the proper clearance in different cases, I desire to add a slight practical correction to the principles he has laid down as to the effects on "sizes" of wear of the lathe shears near head; and as these effects are always sure to make trouble, either in boring or in turning, unless the exact proper position is reached, it is quite an important point.

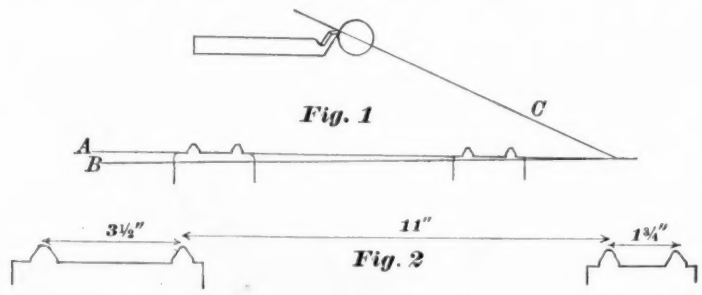


Fig. 1

Fig. 2

In most lathes doing rather large work, the average position of point of tool is nearly over the front ∧, and the carriage is also much heavier at the front than at the back side. This, as will readily be seen, causes more wear on the front than on the back shear, probably from two to five times as much. In Fig. 1, *B* represents the tipping of carriage (exaggerated) from wear, where the wear is supposed to be three times as much on front ∧ as on back one. It is now evident that a tool set to line *C*, as shown, will be least affected by wear; and this agrees very closely with usual practice on small work. It is hard to attain, however, on work six or eight times as large as that represented. If makers would build lathes as in Fig. 2, with front ∧ flatter than the others and back ∧ steeper than the others to guide carriage, with the two front ∧s twice as far apart as rear ones, then the wear would be practically equal, and Mr. Miller's remarks would be entirely correct.

Walter E. Crane.

Minneapolis, Minn.

Heating Surface of Boilers.

Editor American Machinist:

From Mr. Wm. Lowe's letter in No. 12, it seems to be conceded that a domeless tubular boiler can be built and operated without danger to an engine, but he thinks the writer ought to know better than to call boiler tubes a kind of economizer.

This might be passed with the remark that here was a chance for an honest difference of opinion; but the subject of the value of the heating surface of boiler tubes is so important that it will bear some investigation.

On this we must submit to the law governing the transmission of heat, where, the greater the difference of the temperature between two bodies, the more rapid the transmission.

We cannot reduce the temperature of our escaping gases as low as the temperature of the steam, as the heat must be transmitted through metal, and when the temperature of gas and water approach each other, the transmission becomes very slow, and good practice will not sanction a difference nearer than 50° or 75°. Assuming 50° difference to be good practice we will take a plain cylinder boiler to illustrate.

The temperature of the gases leaving the boiler may be taken as 900°, and we wish to economize on our fuel, so we put a lot of tubes into the flue leading from boiler to chimney, with the part nearest the boiler connected to the boiler, and the end farthest from same connected to feed. With such an arrangement if our feed is 100° we can reduce the temperature of escaping gas to 150°.

If we don't wish to do this, we can put the tubes through the boiler; but if we are carrying 70 pounds steam, which equals 316° temperature, we can reclaim the waste heat down to only 366°. The tubes have performed the same office in either case, except that, owing to natural laws, not as efficient in one as the other.

I speak of this more particularly to call attention to practice of many boiler makers, who, to undersell competitors and furnish the greatest amount of "horse-power," *i. e.*, heating surface, will contrive to crowd the shell full of tubes, so that, in some extreme cases, one-half of the tubes are a detriment to the boiler, as only enough should be put in to allow for a good draft and to reduce the temperature to some 75° above the steam.

It having been proved by actual experiment that the lower tubes of a boiler were valueless for heating surface, and that they interfered with proper circulation, some boiler makers are leaving them out of the bottom, but instead of leaving them out of the boiler, are putting them in above the center line, reducing the disengaging surface, and making boilers that prime and pulsate, and which are anything but desirable steam generators; and it all comes from the pertinacity with which some men cling to the idea of the wonderful value of the heating surface of the tubes. W. E. Crane.

An Inquiry Answered.

Editor American Machinist:

In reply to inquiry of W. M. F.: In the first place, I would reduce speed of blower, if not all through the heat, at least after it begins to blow through.

A cupola properly lined will not need lining more than once a year. Lay your brick in fire clay. Mix some fire clay and some ground fire brick—old brick will do. Make it thin, so it will run, pour some of this on each course of brick to fill the crevices, and keep the heat from between the brick; for daubing use fire clay and a little sharp sand, and there will be no further trouble. Wm. Stuart.

Wilmington, Del.

Burning Out of Cupolas—Tests Wanted.

Editor American Machinist:

In answer to W. M. F. on inquiry in regard to cupola burning out, I would inform him that he is getting too much pressure for the size of his cupola. And, if he will put a blast gate on his pipe, and cut off half of his pressure he will find that his cupola will not burn out as fast. The No. 3 Sturtevant blower would be large enough for that size cupola.

Will some of our foundrymen give me the strongest test that they have made on test bars two feet long by one inch square, and the grades of iron they were taken from? David Spence.

"Hardening" and "Non-Hardening."

Editor American Machinist:

I feel some delicacy about writing under this head, since reading Mr. Goodyear's article, for, though he does not say I am not a practical man, what he does say leads me to fear some of your readers may think I am merely a theorist.

I would like to write a chapter on the subject, but, as my time and your space are limited, I will have to be content with introducing myself to you and answering some of Mr. Goodyear's objections.

I have had a smattering of technical education, and also some practical experience, but, as my years are tender, I have had to supplement my personal knowledge by rubbing against some of the truly practical machinists; I do not look upon this as robbery, for, though I have gained by the contact, no one has lost.

My intercourse with scientific men has taught me the value of a strict adherence to truth in statements of facts and observations, even though said statements may not agree with one's previous position.

I have seen how very strong truth makes the scientific man, and have tried to appropriate his strength. Consequently I have resolved never to lie to myself if I can help it, and never to lie to other men unless some good can be gained by it.

If I told you I tempered more steel each day than any other man in Massachusetts you would think I had broken my rule of truth, and your thinking so would be as bad for me as if it were so, therefore I will say nothing of the kind. But in moderation I may state I tempered a few pounds each day, and the sum total may, perhaps, reach tons, enough to entitle me to call myself a semi-practical man.

However, you have no columns for letters from semi-practical men, and I will have to ask your generosity in giving me a place here.

Since I am a theoretical man I will have to defend my theories.

Mr. Goodyear says I have failed to make my statements consistent. I was at first a little alarmed, thinking I had carelessly misstated the facts or the printer (poor fellow) had set it up wrong. But, by reading the article again, I see the facts are stated correctly.

If the rail is straight while cold, it follows that it will be straight at any temperature, provided the head and flange are both at that temperature, and the molecular condition is the same; therefore to make the head convex it is not necessary to have the flange hotter than it was at some previous time, but only hotter than the head is at the time of observation. Understand me clearly; I have spoken of the self-heating while cooling, because the evidence seems to point to that as a fact.

In the first place, while when watching steel in the dark, it appears to do this, in the second place it re-expands while cooling. Mr. Goodyear has promised to try these experiments and give us the results, and I hope he will do so as speedily as possible. He can readily try the optical experiment in a somewhat dark place, with a piece of high tool steel, which is best for the purpose, and afterward with a piece of iron.

I had a dark room prepared for these experiments, and I have repeated them many times; the bright band commencing as a thread and widening slowly, is very easily observed, but you will have to watch very carefully, and may have to repeat the ex-

periment in order to see the corners hotter than the center after having been cooler; since, from the greater surface exposed to the air at the corners, this can be observed only for a very short time. I have before me an elegant drawing of the appearance, published in Jern. Kontoret's "Annales," but it would be so difficult to reproduce in a relief plate that I will not send it to you.

If Mr. Goodyear has not a good heating furnace at his disposal it will be impossible for him to try the re-expanding experiment; for in order to see it clearly it is necessary to have a uniform heat on a bar a number of feet long: in the meantime, if any one else feels like trying it, I will advise him to prepare a few supports for his bar along the middle (bricks turned cornerwise will answer), else, at the temperature at which re-expansion takes place, the middle of the bar will drop down, and the result will be somewhat modified.

I have dwelt more on this question than I intended, for I want to give a little time to Mr. Goodyear's stumbling block, "hardening" and "non-hardening."

You will notice, Mr. Goodyear, that in my first article, in the issue of January 15th, I use the terms "hardening" and "cement" carbon; but it was in a connection where it would have been discourteous to the man from whom I was quoting to use other terms. I afterward explained why I preferred the use of the other terms, though I did not go into the reasons as fully as I might have done, and I will try to do so now.

The chemical relation of carbon to steel is something for the chemist to decide, as at present our knowledge on the subject is very limited. What we do know, and know certainly, is that there are at least three chemical forms of carbon in steel, and I only drew on the chemist for one term (graphitic), which can lead to no confusion, since that form of carbon is not in dispute. As another of these kinds of carbon is found in hardened steel, I (passing by its chemical relation) call it "hardening" carbon, while, since the third form is found in annealed steel, I call it "non-hardening" carbon.

Is there anything complicated or impractical in this? These, or some equivalent terms, seem to be necessary in the discussion of the subject; for in the process of hardening steel, or annealing it, the carbon changes from one of these forms to the other; and as this change occurs while the steel is hot, it would be improper to say "hardened" and "annealed," because a hot piece of steel is not hardened. The terms "hardened" and "annealed" refer to cold steel usually, and it would be poor policy to overburden these words when we have such simple and meaning terms as "hardening" and "non-hardening" carbon to apply to the chemical state (whatever it may be) of carbon in steel, whether it be hot or cold.

As to the varying hardness question, I fear Mr. Goodyear has not interpreted me correctly, as will be seen by reference to my article; I did not refer to temperature above the hardening temperature, but I will acknowledge that my statement, as it stands, is not correct, except in a general sense, as there is a slight hardening below the hardening temperature, and the boundary line is not so sharply drawn as a line might be drawn with a pencil; however, if any one will take the trouble to read carefully what I have said, having the hardness diagram published in the issue of March 19 before him, I think he will have no trouble in understanding my meaning. Good speed, Brother Goodyear, in your efforts to see the appropriateness of the terms "hardening" and "non-hardening," and in the meantime we will wait anxiously for your report in verification or refutation of my statement in regard to the cooling steel.

JOHN COFFIN.

A Good Record for a Turning Tool.

Editor American Machinist:

I have on my table a diamond point lathe tool which has busied me for the past few minutes in the way of getting its dimensions, clearance angles, height of point, inclination of cutting edge, etc.

Will you kindly permit me to describe this tool, as a little later I have something to write in relation to the record the tool has made, and consider this a case where it will do no harm to know beforehand why the tool should have accomplished what it has?

The tool is from $1\frac{1}{4}'' \times \frac{1}{2}''$ American tool steel. It weighs $1\frac{1}{2}$ pounds; cost of steel 30 cents. As it rests on its edge on the table I find on measuring up to the point $1\frac{1}{2}''$. Up to the heel of the cutting edge is $1\frac{9}{16}''$. That is, the point of the tool is depressed below the horizontal $\frac{1}{16}''$ in the width of the cutting edge, which is $\frac{1}{2}''$ wide. Trying the protractor bevel on the clearance angles from the horizontal line I find the reading 75°. Straddling the cutting edge—the wedge which is driven under the chip—I find the reading on the protractor to be 45°. This sums up thus: Clearance angle 15° out of vertical; cutting angle—shear from cutting edge back and downward, 30° out of horizontal. This angle of shear in grinding produces at the top of the $\frac{1}{2}''$ square blade a face of $\frac{3}{4}'' \times \frac{1}{2}''$. I believe this description to be accurate.

In a former letter on proper angles for clearance and cut, in such tools, I took the ground that as little clearance as would insure immunity from the danger of riding, as the tool became blunted and dulled somewhat, was desirable, as it threw the strain of cutting upon the blade of the tool in the direction in which it could be best borne, and also permitted grinding the top angle to a desirable shear without weakening the edge too much. To write here that to secure these conditions depends as much upon how the tool is set, as upon the shape of the tool, would be further repeating what I have written for your columns before. This tool was set admirably. The mark of the set screw, which held it in the tool post, is just 3" back from the cutting point. The front of the supporting collar was only $1\frac{1}{4}''$ back from the point. It was solid, as it had no blocking under it, but came just the right height without that villainous blocking out of level, which makes some tools a nuisance, the angles of which are only suited to a horizontal position of their bodies. The man who ordered the tool made, knew the lathe, knew the job for which the tool was to be used, and the tool dresser who made it could comprehend the instructions he had, and was willing to govern himself accordingly. What of it? I will tell you. I found this tool at work roughing out a lot of shafts $3\frac{1}{2}''$ diameter by 22" long. Weight in rough, 60 pounds. The tool was working so well—the great curling chips were piled under the lathe and twirling away from the tool in a way which all machinists admire—that I stopped to watch the splendid work this tool was doing, and as I took in the faultless shape of the tool for the lathe in which it was being used, the perfection of grinding and setting, saw the great chips roll off, and the smoke from the tool reaching half way up to the ceiling, I began to investigate.

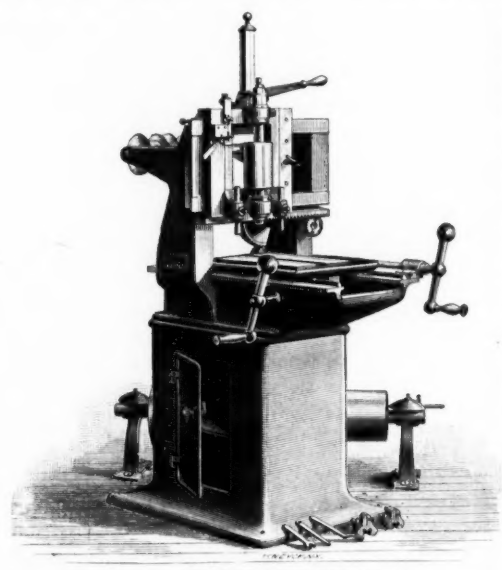
The shafts were machinery steel. For $6\frac{3}{8}''$ at one end, and $4\frac{3}{8}''$ at the other, they were turned down to $2\frac{1}{8}''$. This was done at two chips; $\frac{3}{4}''$ reduction the first chip, $\frac{5}{8}''$ the second; 7" of the remaining length was turned to $3\frac{1}{8}''$; the remaining $4\frac{1}{4}''$ was turned to $3\frac{7}{16}''$. I weighed a shaft after the turning—23 pounds had been removed. I timed the revolution and found the surface speed on the $3\frac{1}{2}''$ down to $2\frac{3}{4}''$ cuts, was 18 feet per minute. The feed was 40 to the inch.

"How often do you grind?" I asked the latheman. "Run nearly all day without grinding sometimes," was the answer. "How many do you turn in a day?" I asked. He answered, "six."

I was anxious to see so light a lathe tool, at a speed and chip which made the smoke rise, run ten hours without grinding. I had recently seen a planer tool stand to plane steel ten hours without taking out, but with a lathe tool there was no chance to rest and cool off. With all my experimenting and theorizing on the possibilities in cutting steel, here was a chance for verification, or contradiction, of assertions I had made, which captured and delighted me.

It was like a continual feast to see a tool at work, which in its shape and setting came so near the ideal which for almost forty years of shop life I had been at first urged to strive for, later had been urging hundreds of others to strive for, and later still, if readers take in all of "Letters from Practical Men," had urged thousands to strive for. Here was the tool.

But it was not all a matter of shape or setting. The steel from which the tool was made was superb. The old notion that "anything was good enough for lathe tools," had not applied in this case; and, another thing—this tool had not been hardened at a heat which made it necessary to draw it to a purple, or brown, or straw, or any other color. No. It was hardened at so low a heat that the scale was not disturbed in the least. The temper was not drawn at all. Not even was it "just started, to take off the strain."



PROFILER OR VERTICAL SPINDLE MILLING MACHINE.

"Won't break, can't break it," said the man. "If it was going to break, that first chip on a little light tool like that would fetch it. I tell you it is a good tool." It is. I watched its working, timed it, brought home chips from it, and have the tool and its record. It stood without grinding, without removing from the tool post, or being sharpened in any way, to turn 18 such shafts as I have described, turning off 414 pounds of steel chips. The actual working time was $28\frac{1}{2}$ hours. How does this strike the readers of that yarn about "whittling a steel key with the blade of a pocket knife?" If such tools are available, can be had for the outlay required to buy a first-class cast-steel, and the careful proper treatment it should have in forging and hardening, and then, with the tools put in the machinists' hands, intelligent, interested grinding and setting will show such results in whittling steel as above recorded, why should there not be as much of interest manifested in a recital of the facts, as there has been in the widely copied article about "a cold chisel made from cheap tire steel," which, by hardening and tempering by some secret process, would chip hard material which resisted all efforts to cut it with best cast-steel tools? Why should the reading public have served up as marvels the facts that chilled iron has been drilled through the agency of some newly discovered secret process of tempering applied to the drill, when it is a fact that in the different shops in the country where chilled rolls are turned, enough of the hard stuff is turned into chips daily to stall a locomotive on dead level, if it could all be gathered from a day's cutting and used as the loadings of a freight train?

Why should the public be expected to swallow in gaping wonder the astounding (?) information that a carpenter's chisel, by being tempered by a wonderful, newly-discovered secret process, has cut iron as though it was so much wood? And that malleable iron shears have been converted into finest steel by another process is more of the "stuff" which is going the rounds of the press. Let's analyze this matter of turning off 414 pounds of steel at one grinding of the tool. Almost a cubic foot of steel converted to chips, $\frac{1}{8}$ of a cubic foot, say, for convenience. Equivalent to cutting off a chip $\frac{1}{4}''$ deep on a surface of 40 square feet or $\frac{1}{8}$ deep on 80 square feet, or $\frac{1}{16}$ deep on 160 square feet, and with a cut $\frac{1}{32}$ deep, 320 square feet, $\frac{1}{32}''$ chip. That is what is taken off on a side in turning shafting, and under the modern method the $\frac{1}{16}''$ reduction in diameter made in turning shafting is divided among three tools, *i. e.*, a roughing tool, one making a second cut, and a square-nosed finishing tool. How many feet in length of $2\frac{1}{2}''$ shafting turned to $2\frac{7}{16}''$ would be represented by this 320 square feet, $\frac{1}{32}$ thick, which it appears our tool which is under consideration turned off? Would be about 470 feet in length, would it not?

It seems to me that I heard a shafting turner bragging about a tool standing to do its share of the cutting on 30 feet of such shaft, and another man said his crack tool, to which his mind reverts as the incomparable one which he has never seen matched, turned 60 feet, while still another man runs the record up to 120 feet. It is a little like stories about catching big fish, is it not? And it is possible that my story about a tool which did the equivalent of turning about 470 feet in length of $2\frac{1}{2}''$ shafting unaided, and unground, from the time the turning commenced, will be beaten out of sight when the returns are all in. But in the meantime I shall think that for a diamond point from $1\frac{1}{4}'' \times \frac{1}{2}''$ steel, with much of its work done at a depth of cut covering the entire depth of cut of which the blade was capable, this, which I have described, is worthy of notice. Some of the chips from the seventeenth shaft, after the tool had turned off over 380 pounds, I have sent you by mail. The sweeper got the start of me on those from the last one. S. W. GOODYEAR.

Profiler or Vertical Spindle Milling Machine.

We illustrate this week an improved profiling machine lately brought out by E. E. Garvin & Co., 139, 141 and 143 Centre street, New York. The table and traversing slide carrying the spindle are each moved by the ball handles shown, and the combination of the two movements makes it possible to follow any irregular outline. The operator has perfect control of the cutter, while the work is always in plain sight. The machine can be profitably employed in spotting off and facing work, die sinking, key seating, edge milling, milling plain or T-slots; cutting cam grooves on cylinders, and also on a large variety of brass work. For facing off, this style of milling gives a perfect surface, and when the finished spots are on different levels, the spindle slide can be accurately raised or lowered by the lever, and positioned by notch which has screw adjustment. Allowance is made for taking up wear in the racks and gears, and the spindle slide is balanced by a spring. Stops are provided for the cross-slide and table. Changes of speed are provided for by cones on the countershafts.

A few years ago practice in the British Patent Office was modified, especially with a view to permit inventors to transact business in taking out patents directly with the office. It is now pointed out—and this is just what would be expected—that many patentees lose the best part of their inventions through ignorance in not correctly specifying what they have invented. A man not conversant with patent matters would stand less chance of doing a good job in preparing specifications and claims for patents than a blacksmith would in framing a house.

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NEW YORK, APRIL 23, 1887.

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In the Interest of Free Waterways.

Those who have seen the enormous "tows" of canal boats coming down the Hudson River from Albany, towed by a comparatively insignificant steamboat, must have been impressed with the fact that it is a remarkably cheap way to get freight from the Erie and Champlain canals to New York. Shippers by barge, either up or down the river, have also had occasion to think of this when paying winter rates by railroad. If the proposed bridge is built across the Hudson at Poughkeepsie it will virtually put a stop to these cheap rates, because tows could not be taken through between the piers. However desirable it may be, for other reasons, to bridge the Hudson at Poughkeepsie, in the interest of cheap transportation it should never be permitted unless by some means that require no piers in the river. It would be not only disastrous, so far as the Hudson River is concerned, but it would be a serious blow to the canal interests of the State of New York, and incidentally the bad effects would be felt on the lakes, and by thousands of farmers beyond the limits of the State.

It is urged that money has been expended by the company that proposes to build the bridge, upon faith in the permission granted by the State. But the company has certainly failed to keep its contract, and has lost its right. If there is no other honorable way out of the matter, then it would be wise for the State to pay for its foolishness in granting this permission. The Hudson River and the canals of the State are particularly democratic institutions. Hundreds of people with small means engage in the service of transportation on them, not only to their own profit, but to the advantage of the whole country. The rights of these people should be zealously guarded against the encroachments of great corporations. By all means let the railroads get across the river, but let them do it without further impeding navigation. There ought to be no pier bridges between New York and Albany.

If two-thirds of the machine shops in the country would keep a careful account of the time required to hunt up tools and appliances required in doing work, they would have at hand a strong argument for establishing tool rooms.

Hotel Elevators.

The hotel fire at Buffalo has stirred up the usual outcry against elevators, and a Buffalo legislator proposes to provide a remedy by bringing about the passage of a law that no elevator shaft shall be permitted within a less distance than twenty feet of a stairway. This might be well enough in the instance of new buildings, but in the case of many existing buildings the enforcement of such a law would entail a large expense, without, it seems to us, accomplishing as much as could be accomplished by much simpler and less costly means. It is certainly more in reason to look for some means less sweeping than changing the whole interior arrangement of buildings from five to ten stories in height.

An elevator shaft is a source of danger in that it acts as a flue or chimney for a fire in the lower stories, and the interior of the shaft being inflammable, fire is communicated to the upper stories with wonderful rapidity. Why not, then, enact that the shaft, and all its connections, be made fire-proof, to prevent fire following it up, and do away with its functions as a chimney by providing automatic fire-proof hatches at every floor?

This would put owners to considerable expense, but the increased safety of the building would more than compensate for this, and the public, as in the case of hotel guests, would be better protected than by locating the shaft somewhere else, leaving it as it is.

Legislation looking to safety by modifications in elevator shafts where they are would not meet with serious opposition, and by turning attention in that direction some good may be realized; it is certainly needed. By trying to inaugurate measures that imply an enormous outlay the result will be that opposition will be so strong that nothing will be done.

Make It Plain.

We receive in the course of a year a great many circulars, and even pretentious trade catalogues, the make-up of which shows an evident intention not to tell something. This is bad policy. It ought before this to have been impressed upon the minds of those who issue circulars and catalogues that the men they seek to reach are not impressed by generalities. This we know is true in the machine and allied trades. Master mechanics, superintendents, shopmen, are all busy men, and have never the least interest in the statement that John Smith has the best device in the world for some particular purpose. Anyone can make this statement, but it does not amount to the value of the paper upon which it is printed. If there is solid argument and illustration of why a particular machine is good, the argument setting this forth is sure to be appreciated by busy men. Noting what is being done in such things is part of their business—part of that which keeps them busy.

There seems sometimes to be an idea that it is dangerous to let it be known exactly what makes a machine good; it is often acknowledged in conversation that it is believed that to do so would give competitors undue advantage. This is hallucination, pure and simple. When an article is made and sold, anyone really determined upon finding how it is done will always be able to do so.

When a manufacturer makes his construction public there is much less probability of his being copied than when he tries to hide it; in the latter case there are those who feel put upon their mettle to find out what he is doing.

In every instance where manufacturers are describing their products, our experience is that the more complete the description the better. If there is a sort of generalization that tells nothing, the assumption is that there is nothing to tell.

The Union Pacific Railway Company, according to the *Union Pacific Employes' Magazine*, attaches a release to the agreement under which apprentices are employed, which prevents any recourse in case of accident, even though the accident comes from direct negligence of the company. This is all very nice in theory; but there are certain rights that no man can sign away, either for himself or another, and, in some instances at least, this will be found to be one of them. At the best, it is small business for a great railroad corporation.

A foreign contemporary has a query, "How can I sell a patent?" We give it up; but if it comes to buying patents, we can help the interrogator. There are a few hundred thousand in this country that can be bought cheap.

Literary Notes.

The Brown & Sharpe M'f'g. Co., Providence, R. I., have issued a second edition of their "Practical Treatise on Gearing." The volume has been slightly revised and a new and attractive frontispiece showing their works has been added. It is a popular work for mechanics. Price, $2.10.

The Crank is the title of a new publication to be issued monthly by the students of the Sibley College of the Cornell University. Notwithstanding the significance of the name, we do not see anything peculiarly cranky in the first production. Just like all similar efforts, *The Crank* will prosper according to its merits, and the students of Sibley College are, we believe, competent to look after this. *The Crank* will be issued monthly at $1.25 per year.

The Temple is a new Masonic weekly, the first number bearing date of March 26th. It has sixteen pages, and both the print and the general arrangement of matter are good. There are departments for fashion, agriculture, the turf, chess and checkers, and theatrical matters, in addition to the regular Masonic notes and news. It is published by the Wright Publishing Company, 19 Murray street, New York, at $2.50 a year. The president, Richard B. Wright, has been for several years engaged in the office of the American Machinist, and leaves his position to devote himself to the new paper. We wish success to the new venture.

The *Practical Engineer* is a new one penny mechanical weekly just started in Manchester, England. It starts off well and seems to have a good support. We wish it full success. The subscription price for the United States is eight shillings and sixpence, which is about $2.12 in our currency.

LADD'S DISCOUNT BOOK. COMPILED AND EDited by William J. Ladd.

This book is certainly a wonderful production, showing hard work, ingenuity and the author's rare ability for work of vast detail, together with mathematical precision. By an ingeniously contrived index any discount can be referred to instantly, and the net of any amount be obtained at a glance. We know that there is a prejudice against new ways of working; but this book impresses us as being, as claimed, "a practical means for rapidly reaching absolutely accurate results without the mental wear of computing, avoiding any possibility of error;" and if this is so, it is only a question of time when it will be in general use by all who have occasion to deal with percentage. Besides finding the net amount, the explanation shows the book to be valuable also for making prices, comparing prices, figuring profits, etc. Mr. Ladd has been connected with the hardware house of Sargent & Co., of this city, for many years, and superintends their publications; he is a practical business man, thoroughly familiar with the intricacies of percentage and the uses of discounts. The book is from the press of J. W. Pratt & Son, and apparently no expense has been spared to make it attractive, as well as "accurate, rapid and practical."

The book is sold by Sargent & Co., New York, at $3 a copy, postage prepaid.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(183) W. M. C., Fayetteville, Ark., asks: What is the best machine shop floor, laid directly on the ground? *A.*—For full description of such a floor, with drawings, see American Machinist of November 8, 1884.

(184) J. L. L., Hickory, N. C., asks: Is there any method by which the extreme hardness of castings made from old scrap can be avoided without mixing pig iron with it? *A.*—There is no way this can be avoided excepting by mixing pig or annealing the castings. By using some of the softer grades of Southern iron, the quantity of pig may be reduced.

(185) N. H., Camden, N. J., asks: 1. Which of the transatlantic steamers burns the most coal per day, and how much? *A.*—There is not much difference in coal burned per day as between some of the largest. They burn about 300 tons. 2. Which is the best book on geometry for a beginner? *A.*—We do not think there is very much difference.

(186) J. W., Buffalo, N. Y., writes: I wish to get a rule for size of condensers necessary for various-sized engines. Is there a book published giving designs of condensers? *A.*—There is no uniformity in sizes of condensers as made by different builders. You will find in various works on engineering drawings of condensers, and in engineers' pocket books, rules for proportion.

(187) J. F., Boston, Mass., asks: What is the difference between a friction and a positive clutch, and which is the best? *A.*—With a friction clutch the holding is done by friction; so in getting up the speed there is chance for a little slippage. With a positive clutch the connection is made positive; hence there is more liability of breakage. For most purposes the friction clutch is best.

(188) W. J. D., Campbellton, N. B., asks: 1. How high will a No. 8 Mack injector lift water? *A.*—A Mack lifting injector will probably lift water from 15 to 20 feet, perhaps higher, under exceptionally good conditions. 2. If it is 8 feet from tank to where water goes into boiler, what height should injector be placed? *A.*—We should always, if possible, place the injector below the water in tank.

(189) E. K., McKeesport, Pa., asks: Will a blower with an air-tight box, or nearly so, give as good results as without it? *A.*—If the blowe is in an air-tight box, it can get no air, and consequently will deliver none. 2.—Why are pulleys of large diameter with narrow belts preferable to small pulleys and wide belts? *A.*—Belts get better hold of large pulleys than of those very small; there is not so much power lost in bending the belt.

(190) J. F. R., San Francisco, Cal., asks: How can I get a red color on yellow brass castings? *A.*—The red color on brass castings, as they come from the sand, is due to the metal from which the castings are made, and the degree of heat in them when they are exposed to the atmosphere. You cannot expect to give yellow brass castings the red color you speak of, because the metal they are made of prohibits it. They ought to look just what they are.

(191) J. L., Ottawa, Canada, asks: Will you explain with diagrams how the cut-off used on tug engines is proportioned, and is the eccentric set exactly opposite the crank? *A.*—We presume you refer to the Meyer cut-off. You will find the arrangement explained in the AMERICAN MACHINIST of February 4 and April 1, 1882. The eccentric for this form of cut-off is usually set exactly opposite the crank, so the boat will back when engine is reversed, as in case of an emergency.

(192) W. L. Brooklyn, N. Y., writes: We have a boiler working under 50 lbs. pressure. The steam pipe to engine is 1⅝ inches, and 50 feet long. The question is, What pressure is there in the cylinder, or how can I determine what pressure is lost in the pipe? *A.*—Put a steam gauge on the pipe close to the engine; then, by noting the difference in pressure between there and the boiler, you will see what is lost in the pipe. Compare the readings of the two gauges when the throttle valve is closed, so as to note if the gauges register alike.

(193) W. H. Williams, Bloomfield, Canada, writes: Some engineers claim that there is no advantage in blowing off a boiler under pressure, as the scale sticks fast and does not loosen and fall to the bottom, as it would do if the water were allowed to become cool. I claim that in blowing off a boiler under pressure a greater part of the mud and scale in the bottom of the boiler will be blown out with the water and steam, and hence that it is better to blow off under pressure. Which is right? *A.*—It is very generally believed that in all boilers where the scale and dirt can be removed from the bottom by scrapers and washing it is better to let the water out cold, or nearly so. By doing this more of the scale is likely to be dissolved and loosened, and there is less danger from sudden contraction.

(194) J. F. M., Port Moody, B. C., writes: 1. Will it affect the weight on the driving wheels of a locomotive (four-wheeled, coupled) by raising or lowering her in front, providing you do not raise or lower her enough to let the frame rest on the boxes? *A.*—Yes. By raising the locomotive in front the water in the boiler will be thrown back, and consequently the weight on drivers increased. Even when the boiler is empty, if the front end is raised without changing the spring hangers, more weight will be thrown on the drivers. And for similar reasons the weight on the drivers will be decreased when the front end of the locomotive is lowered. 2. What is the most convenient way of increasing the weight on driving wheels? *A.*—Some master mechanics will increase the thickness of the foot-plate; we have seen foot-plates 6 inches thick. Others will make cast-iron ash-pans from two to three inches thick. But it should be remembered that light weight on the drivers indicates faulty construction; if the boiler is made sufficiently large to suit the cylinder and speed required, and the frames and other parts correctly proportioned to withstand all the strains, all the necessary weight on the drivers will have been obtained.

(195) J. O., Gloucester, Mass., writes: Is it scientifically proven that it is a measure of safety to check the speed of trains in passing over bridges or other parts of a railroad where weakness may exist? I ask because I cannot reason it so. Experience does not indicate that the strain of a moving body upon its point of support is lessened by diminishing its velocity. For instance, no skater thinks it safe to take a snail's pace in getting over thin ice. But even if it is safer to go slow on bridges, I can't see the sense of using brakes to accomplish it, as is often done. *A.*—To check the speed of a train in passing over a bridge is certainly a measure of safety. The oblique action of the connecting rods and the vertical action of the centrifugal force cause what some engineers call the hammer blow on the rail, and this blow or vertical action becomes very severe at high speeds; hence the necessity of running slowly. Experience does show the strain of a moving train upon its points of support is lessened by diminishing the velocity of the train. For instance, standing in a depot when a train is passing at full speed, a considerable tremor will be felt, whereas, if the same train comes in slowly, the tremor is scarcely perceptible. You are right in saying that "no skater will take a snail's pace over thin ice;" he certainly will get out of danger as soon as possible, but in the meantime the skater will not take as vigorous strokes to propel himself off the thin ice as he would do on ice which he considered perfectly safe. It is bad practice to use brakes on bridges.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Geo. B. Grant's adv., page 16.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Air Compressors, Rock Drills. J. Clayton, 43 Dey st., NY

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Mach'y Patterns, Wood and Metal; send for estimates. J. Valentine, 15 Alling st., Newark, N. J.

Extra capacity, hollow-spindle Hand Lathes; correspondence solicited. J. R. Rand, Brattleboro, Vt.

Robbs' Patent Composition for case-hardening, send for circular. F. W. Tasney, Paterson, N. J.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

20", 25," 28" B.G. and S. F. upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N. Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Mch. 26, p. 13. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

Practical Handbook on Pump Construction. Various kinds and materials to be made of for different purposes. By P. R. Bjorling. Nine plates, 12mo., $1.50. E. & F. N. Spon, publishers, 35 Murray street, New York.

New Book on Gears; Tables giving 3,094 diameters, with rules for calculation of movements of shafts, etc.; sent on receipt of P. O. Note; price 50 cts. Address C. B. Long, M. E., Worcester, Mass.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

MASON REGULATOR CO., BOSTON, MASS.—Gentlemen: In answer to your inquiry how the Reducing Valves work which we have put in, we would say they are doing all you claim for them, and our customers are well pleased with their working. We think no steam plant can afford to be without them.—Very truly yours, Buerkel & Co., steam heating and plumbing. Boston, Feb. 9, 1887.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES.

Wm. Fitzsimmons will start hot-polished shafting works in Cleveland.

They are about to organize a large cotton factory at Mooresville, N. C.

Pinder & Co., Anniston, Ala., will erect extensive works to build steam engines.

The J. Morton Poole Company, Wilmington, Del., will build a new iron foundry.

Pruder & Co., at Anniston, Ala., machine builders, are to erect additions to their works.

Craig & Williams, Columbia, Tenn., have built an addition to their machine shops, 30x60 feet.

The Athens Foundry and Machine Shops, Athens, Tenn., and J. F. Brewster, Chester, Pa., will enlarge their foundries.

The Steubenville (O.) Board of Improvement is considering a proposition of a party for starting a nail mill there.

The Louisville-Kentucky Woolen Mills Company will build a brick factory, two stories, 65x75 feet. It will cost $7,500.

W. T. Pegnes and others are interested in a cotton-seed oil mill and an ice factory, about to be erected at Mansfield, La.

Murray & Stevenson, at Anniston, Ala., are increasing the capacity of their foundry 33 per cent., and putting in a new blower.

Dennis Long, manufacturer of cast-iron pipe in Louisville, Ky., will erect a building to cost $100,000. The site purchased for it is 56x105 feet.

The Pittsburgh and Lake Erie Railroad will erect machine shops and round-house at Chartiers station, at a cost of $75,000, this summer.

The Knowles Steam Pump Works have moved their offices and warehouse in Boston to large and commodious quarters, 113 Federal street.

C. C. Huckabee, owning a cotton-seed oil mill in Southern Alabama, has formed a $30,000 stock company to move it to Oxanna and enlarge it.

The Rigby Car Wheel Company, St. Paul, Minn.—capital stock, $150,000—has been incorporated by Jas. Rigby and others. Will make car wheels.

The cotton mills of the West Point Manufacturing Company, West Point, Ga., recently burned, will be rebuilt at once. The loss is reported to be $250,000.

The Gardner Governor Company, Quincy, Ill., are making and selling more governors than ever before. One hundred and twenty-five men are employed.

The Cambria Iron Company, of Johnstown, have increased the capacity of their plant for the production of steel axles for railroad passenger and freight cars.

Campbell, VanSycle & Co., and others, have organized the Macon Agricultural Works at Macon, Ga. Will build works immediately to manufacture agricultural implements.

The Birmingham Street Car Factory Company, Birmingham, Ala.—capital stock, $100,000—has been organized to manufacture street cars. Will soon begin building works.

A meeting has lately been held at Shreveport, La., for the purpose of organizing a stock company to build a cotton factory, to cost from $300,000 to $100,000. Henry Florsheimer is interested.

The Geo. F. Blake Manufacturing Company, Boston, have moved their steam pump warehouse and offices to 111 Federal street, where they will have larger and more convenient quarters.

James W. Tufts, manufacturer of soda water apparatus, 33 to 51 Bowker street, Boston, Mass., writes us that he is erecting a new factory, and proposes putting in a new engine and boiler.

H. W. Judge has started in the machine business at 81 Adams street, Brooklyn, N. Y. He will attend particularly to building experimental machinery, do general jobbing work, make dies, tools, etc.

John A. Hart, W. G. McAdoo, M. L. Chapman and others will organize a company, with a capital stock of $250,000, to secure manufactories for Chattanooga, Tenn., and aid in their establishment.

J. H. Duffey, proprietor of the Eagle Iron Works, St. Paul, Minn., is building steam engines, to which he has adapted a valve devised by him, which, it is claimed, brings about superior steam distribution.

It is said that A. Hegewisch, of New York, president of the United States Rolling Stock Company, has been prospecting at Anniston, Ala., with a view of locating car and locomotive works, with a capital of over a million dollars.

A company has been organized at Selma, Ala., to build $20,000 rolling mill, another company to establish $25,000 chain works, and another company, $25,000 capital, to make stoves. E. R. Kinsey is interested in some of the companies.

E. E. Garvin & Co., Centre street, New York, have issued a new catalogue of 64 pages, finely illustrated with cuts of the specialties which they manufacture. The catalogue is a fine one, and will afford information to every mechanic.

Several engine and boiler establishments unite in reporting that brick-yards in the vicinity of New York are specially busy, and a number of them are increasing their motive power facilities. This probably means that a brisk building season is ahead of us.

The Government of New South Wales wants 44 locomotives, and cares not who builds them so long as they are built according to the specifications in the hands of R. W. Cameron & Co., 23 South William street, New York, and the price suits. The contract is open to the world.

The Knox Woolen Mills, Camden, Me., are having such an increased demand for their productions that they are about to build a new mill, 40x100, three stories, thus nearly doubling their present capacity. This company have been established about fifteen years.

Messrs. E. B. Borden, B. M. Privett, Henry Lee and others have organized a company who will build a furniture factory at Goldsboro, N. C. The city has contracted with Moffett, Hodgkins & Clarke, of Watertown, N. Y., for a complete set of waterworks for fire and domestic purposes.

The Baltimore *Manufacturers' Record* says: "The report of large steel works being built near the city is confirmed. J. Wesley Guest, of Baltimore, and others, have purchased 1,200 acres of land, and will erect works to make steel rails, build steel ships, etc. Several million dollars will be invested."

The New York and Brooklyn Bridge arch in York street, Brooklyn, has been leased by the Clayton Air Compressor Works, of 43 Dey street, New York, for use as a warehouse for the storage of air compressors of the larger sizes, as the pressure of orders at their works requires all the available floor space.

Articles of association have been filed at the Wisconsin Secretary of State's office by the Reliance Wire Company, of Milwaukee, with $20,000 capital stock. Its purpose is to manufacture and deal in wire of all kinds and wire goods. The incorporators are Frank A. Hall, W. N. Fitzgerald and Oscar F. Lindman.

The Shipman Engine Company, of 92 Pearl street, Boston, Mass., has issued a new catalogue descriptive of their petroleum engine, which seems to be meeting with excellent success. Engines are illustrated for both stationary and launch purposes, and many testimonials are given, showing how they work.

It is said that a company with a capital from $100,000 and upwards will be organized at Fayetteville, Tenn., to use the large water power with which that place is blessed. This company will build mills of various kinds, amongst which will be a 200-barrel roller flour mill and a large cotton factory. A. J. Thomas is interested in the project.

One of the largest boilers ever built in the United States has just been tested at the shops of I. B. Davis & Son, Hartford. It will be at once shipped to the New York Post-Office, where it is to take its place beside another of like size made by the same firm. The pair will be used to generate steam for the dynamos which operate the electric lights of the building. The boiler weighs nine tons, and has 1,202 square feet of heating surface, giving 186 horse-power.

Wyman & Gordon, Worcester, Mass., are making a line of machine tool handle forgings. There are seven sizes, varying by half-inches from 3 inches to 6 inches in length. They do not require centering to finish, only needing to be polished to give them a fine finish. They are made of Bessemer steel. Business is very good at this establishment. They are just finishing a lot of forgings, making about half a million of one kind made during the last eighteen months.

The *Industrial Journal*, of Bangor, Me., has the following: "A company of prominent Camden (Me.) gentlemen are to organize a company at an early date to build a new woolen mill on Megunticook stream, one-half mile from the village, at what is known as Gould's Mill, the capital to be $100,000. A sufficient amount has already been subscribed to insure its success. They are to manufacture ladies' dress goods. Hon. J. B. Stearns is one of the stockholders, and a prominent manufacturer of this State is to be superintendent."

The Fishkill Landing Machine Company, Fishkill-on-Hudson, N. Y., are running full force, 150 hands, on engines and boilers, with plenty of orders. Some slight improvements have been made by them in their Fishkill-Corliss engine, as illustrated in our November 20, 1886, issue, notably substituting an improved set-screw joint for the gib and key in various parts of the valve mechanism. One of these engines, in use in a factory in New York city, owing to peculiarities of location, has been arranged to work with the valve gear on the crosshead side of the engine.

The city of Toledo, Ohio, possesses many natural advantages that should long since have made it an important manufacturing center, but public interest there has heretofore been given to commercial rather than manufacturing matters. Now the current seems to be changing in a direction far more likely to build up the city. Two natural gas companies—the Produce Exchange Oil and Gas Company and the Ohio Natural Gas and Oil Company—have lately been organized, the latter having a capital stock of $750,000, for the purpose of conveying to Toledo natural gas from several important wells located in its vicinity. Existing railroad facilities make the city a splendid distributing point, and a plentiful natural gas supply could nowhere be made more effective.

The St. Louis *Age of Steel* says: "The Western Brass Manufacturing Company have let all the contracts, and the work of tearing down old walls under the same is now actively in progress, for the erection of a four-story brick factory at No. 615 Walnut street. The new building will have a frontage of 35 feet, a depth of 125 feet, will be modern in all respects, and especially adapted to the company's business. The uppermost floor will be used for foundry purposes, in accordance with the Eastern custom; the third will contain the finishing shops, and the two lower the store. The new quarters are expected to be ready for occupancy in about three months. Only a week or so ago the company completed a new warehouse, 26x60 feet, which, in connection with their present building operations, affords a very clear idea of the rapid growth of their business."

Machinists' Supplies and Iron.

NEW YORK, April 7, 1887.

Iron—Trade in American pig goes on with a humdrum quietness, transactions being mainly in small lots for every-day use. Large consumers are supplied by contract. We quote: No. 1 X standard brands, $21 to $22: No. 2 X, $20 to $20.50; Grey Forge, $18 to $18.50.

Scotch Pig—Few sales are being made, at Coltness, $22.50 to $23; Gartsherrie, $22 to $22.50; Summerlee, $22.50 to $23; Eglinton, $21; Langloan, $21.50 to $22; Dalmellington, $20.50 to $21.

Lead—4.32c. to 4.35c.

Copper—Lake, 10.45c.; Arizona, 10c.

Antimony—Hallett's, 7¼c.; Cookson's, 8⅞c.

Spelter—Refined, 5¾c. to 6c.

Tin—Banca, 23c. to 23¼c.; Straits and Malacca, 22.70c.

✻WANTED✻

"Situation and Help" advertisements only inserted under this head. Rate, 3c. cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

First-class lathe and floor hands. Apply to Betts Machine Co., Wilmington, Del.

A man with theoret. and practical experience wishes situation as designer or foreman of drawing room. Address M. E., AM. MACHINIST.

Wanted—A competent man to superintend a shop building automatic engines. Address Keystone, care AM. MACHINIST.

Wanted—First-class machinist to take charge of tool-room; one capable of making and tempering tools. Address South Carolina, AM. MACHINIST.

An A 1 assistant draftsman, 4 yrs. shop and drafts-room experience, desires situation; first-class reference; moderate salary. B. G., AM. MACHINIST.

Position wanted by a young Swede as mechanical or ship draftsman; best of references. Address Box 23, AM. MACHINIST.

A first-class machinist wants an interest in small foundry and machine shop. Address Box 24, AM. MACHINIST.

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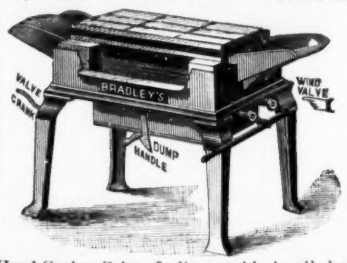

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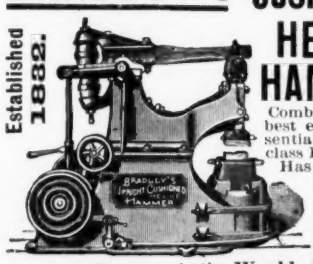

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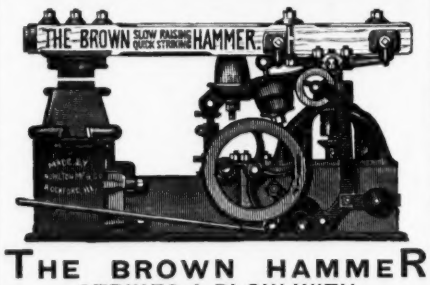

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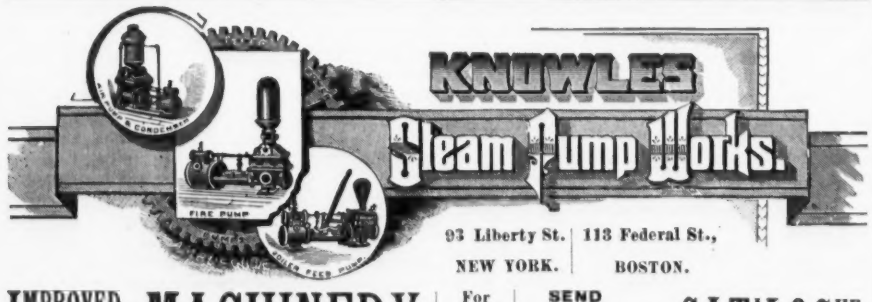

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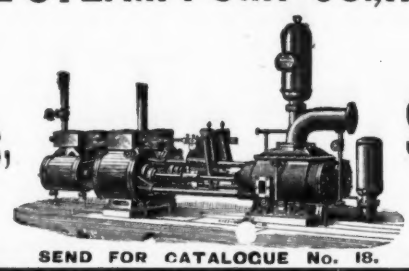

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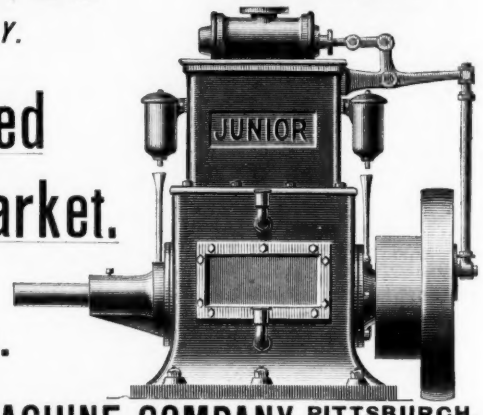

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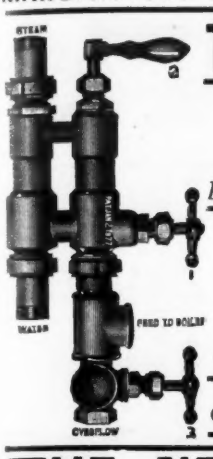

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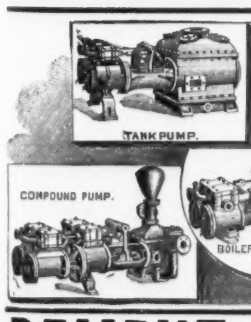

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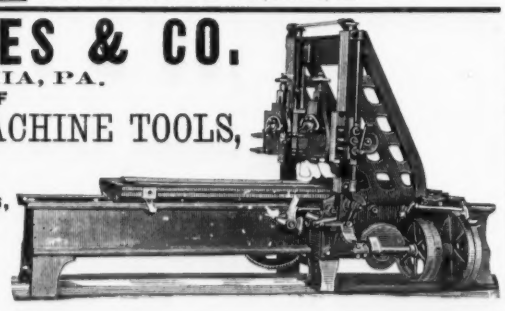

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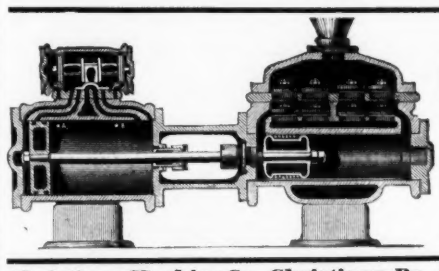

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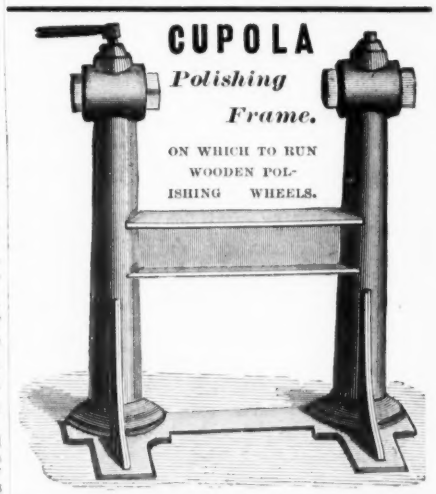

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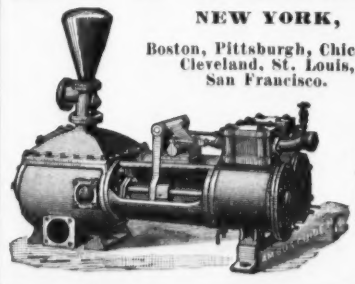

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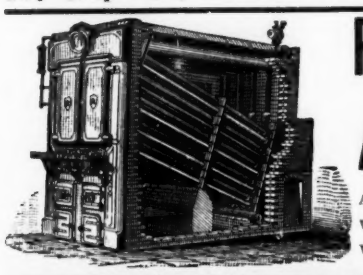

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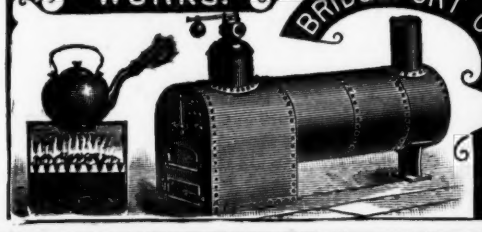

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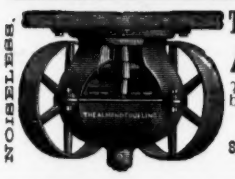

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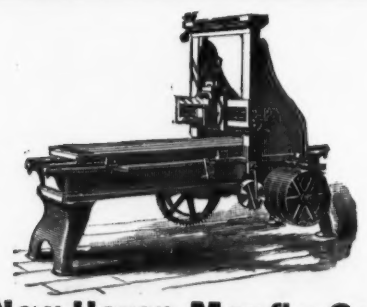

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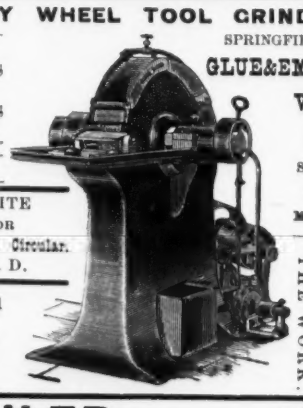

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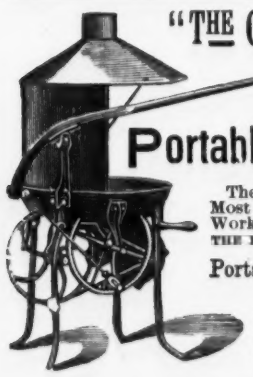

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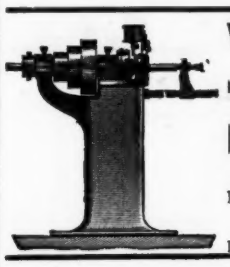

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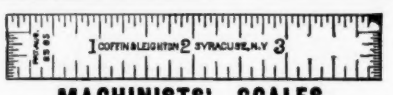

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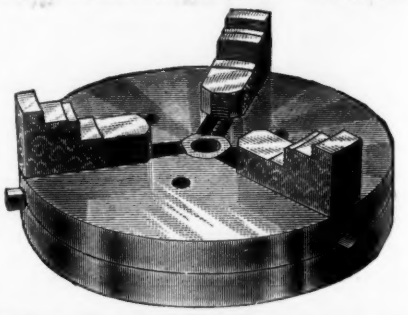

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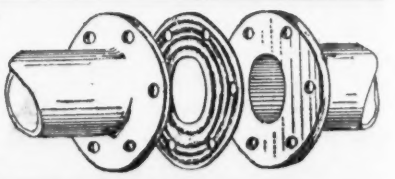

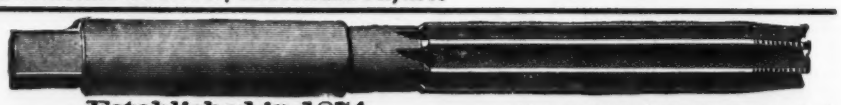

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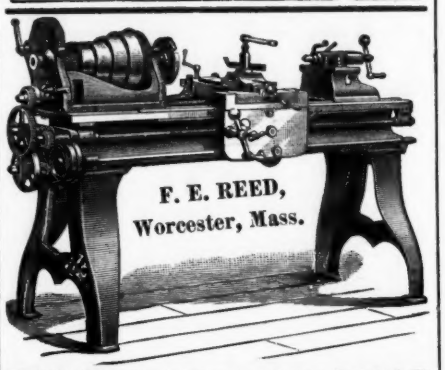

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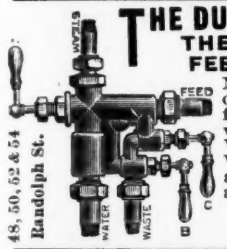

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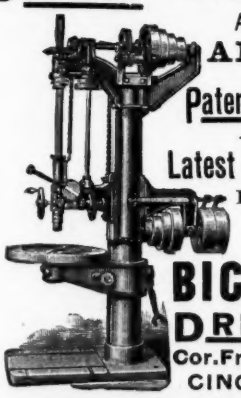

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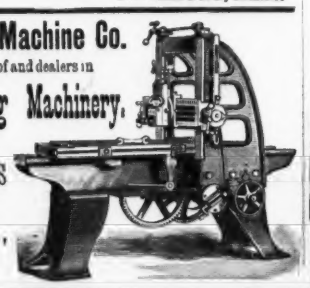

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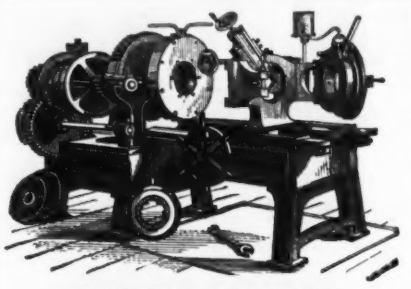

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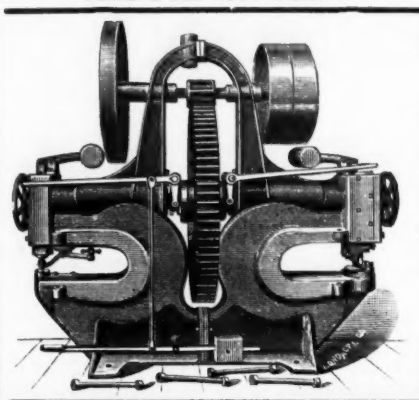

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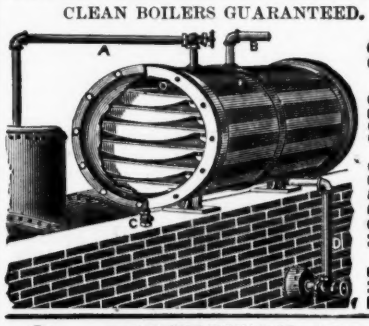

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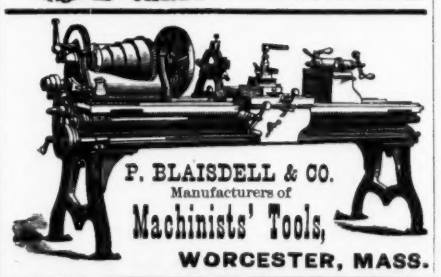

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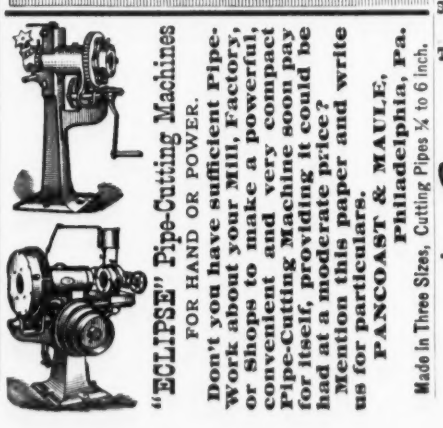

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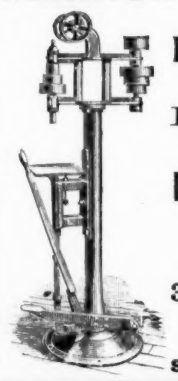

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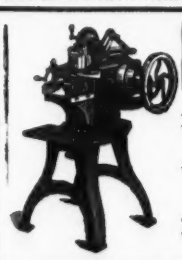

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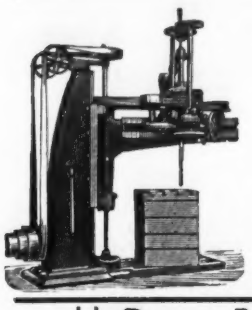

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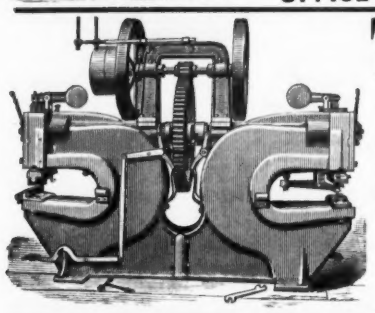

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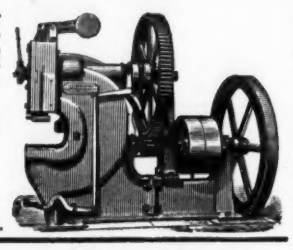

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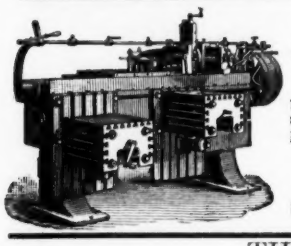

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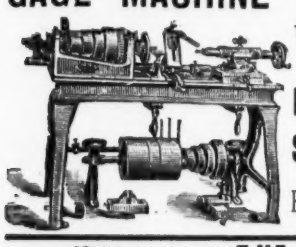

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Manuf'r's of

Fox, Turret AND Speed Lathes AND Brass Finishers' TOOLS.

FOR SALE.

STOCK OF

DRILLS,

Preparatory to turning over business to my successors,

BICKFORD DRILL CO.

Three 20 in. Lever Feed Drills,
Three 24 in. Wheel Feed Drills.

FOR PRICE ADDRESS

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THE NATIONAL FEED-WATER HEATER.

A brass coil heater supplying feed water at 210° to 212° Fahrenheit by use of exhaust steam.

Our prices are low and reasonable, and we aim to supply the *cheapest, best and most effective Heater in the market.* Sixteen sizes. 10 H.P., $20; 100 H P., $150; 500 H. P., $600. Iron, Brass and Copper Coils and Bends made to order Circulars and price lists sent on application.

National Pipe Bending Co.

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IRON LEVELS,

Manufactured by

C. F. RICHARDSON, Athol, Mass.

OSGOOD DREDGE CO., - ALBANY, N. Y.

RALPH R. OSGOOD, Pres. JAMES H BLESSING, Vice-Pres.

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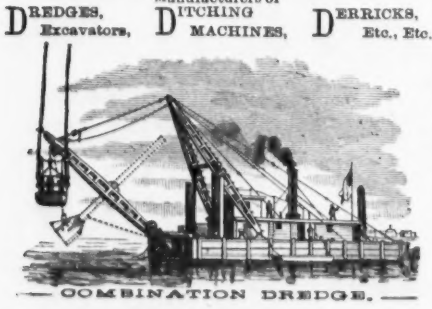
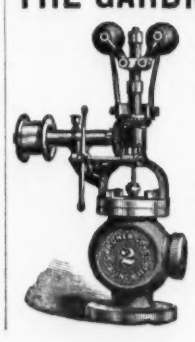
Manufacturers of

DREDGES, Excavators, DITCHING MACHINES, DERRICKS, Etc., Etc.



— COMBINATION DREDGE. —

THE GARDNER GOVERNOR



Over 45,000 in Use.

ADAPTED TO EVERY STYLE OF STATIONARY AND PORTABLE STEAM ENGINE.

Warranted to give satisfaction or no sale.

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The Gardner Governor Co.

QUINCY, ILL.

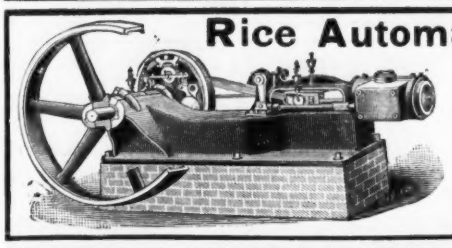
SOUTHWARK FOUNDRY & MACHINE CO.

PHILADELPHIA, PA.

General Machinists, Founders and Boiler Makers,

Heavy Machinery of all Kinds a Specialty.

Rice Automatic Cut-off Engine



Self-Contained. Sensitive Governor.
Balanced Valve. High Speeds.
Stationary Oilers. Best Economy.

Gold Medal Cincinnati Exposition, 1884.

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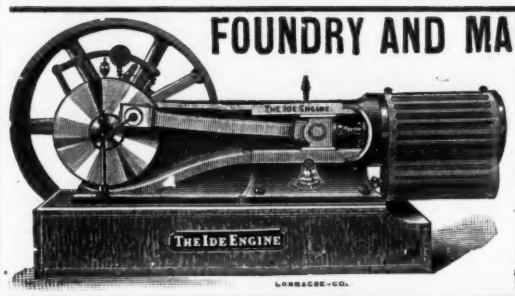

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Highest Award Silver Medal AND Diploma

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SUBSTANTIAL, WELL MADE, LOW PRICED

20 INCH DRILLS,

With latest improvements, Lever or Wheel feed, address

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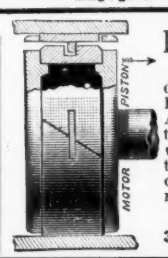

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Perfectly balanced against undue pressure in all directions. Preserves both cylinder and rings. Allows no waste by either friction or leakage. Call and see working model, expressly made to demonstrate advantages claimed. For packing or shop rights, address

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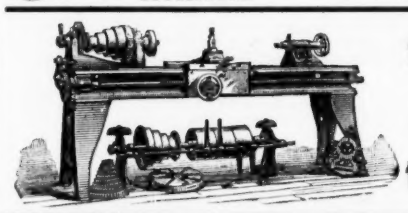

16 in ENGINE LATHES. and 18 in.

NEW DESIGNS

FIRST CLASS WORKMANSHIP.

THE MULLER MACHINE TOOL CO.,

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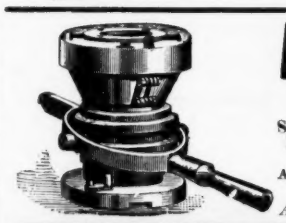

ACME MACHINERY CO.,

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Manufacturers of

"ACME"

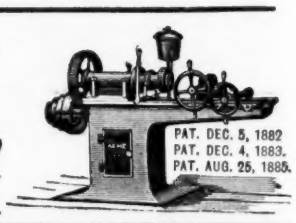
Single & Double Automatic Boltcutters,

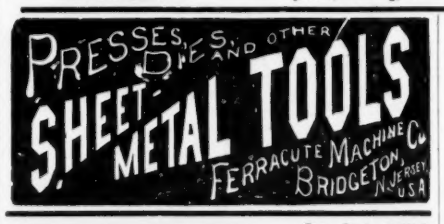
cutting from 3-8 in. to 6 in. diameter,

Also SEPARATE HEADS AND DIES.

Send for Catalogue and Discounts.

Agents, Manning, Maxwell & Moore, New York.





Our Patent Rotating Fans are invaluable for Restaurants, Hotels, Meat Markets, Saloons, Lunch Counters, Groceries, Bakeries, Confectioneries, and in fact all places troubled with *heat* or *flies*. The only perfect Fan made that can be driven at any speed without disturbing the belt.

WE ALSO MANUFACTURE THE CELEBRATED BACKUS WATER MOTOR

Prices, from $6 to $35. Send for circular, to

BACKUS WATER MOTOR CO., NEWARK, N. J

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ENGRAVER ON WOOD

58 ANN ST. NEW YORK.

MACHINERY.

BARGAIN LIST.

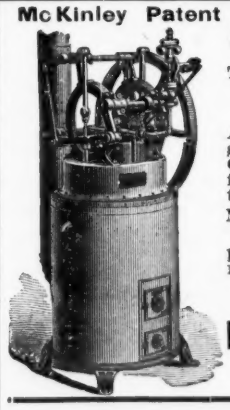
Two	16″	swing,	6′	bed,	Engine Lathes (Porter), new.
One	17″	"	8′	"	" (Wright), "
"	20″	"	8′	"	" " "
"	24″	"	12′	"	" " "
"	22″x 22″x 5′	Pond Planer, second hand.			
"	40	H. P. Stationary Engine			12″x20″ Cyl., new.
"	30	"	"	"	10″x20″ " "
"	35	"	"	"	11″x16′ " "
"	25	"	"	"	10′ x12″ " "
"	20	"	"	"	9″x22″ " 2d. hd.
Four	8	"	"	"	6″x12′ " "
Two	9	"	"	"	6½″x12″ " "
One	15	"	Upright	"	8″x9′ " "
"	10	"	"	"	7″x16″ " "
"	20	"	Coil Boiler (Waterhouse) second hand		
"	8	"	Portable Engine 6′x12″ cyl. "		

Also large stock of new and second hand Engines, Boilers and Machinery, not mentioned above. Correspondence solicited.

S. L. HOLT & CO.,

67 SUDBURY STREET, BOSTON, MASS.

Mc Kinley Patent



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The Best and Cheapest on the Market.

No Steam. No Water. Absolute Safety. No Engineer. No pumps. No Gauges. No liability to freeze up. No Regulation required.

NO EXTRA INSURANCE.

Can be used for any purpose where power is required.

Cheap Fuel. Cheap First Cost.

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FOX'S CORRUGATED BOILER FURNACES

MANUFACTURED BY

THE LEEDS FORGE CO., Limited, of England.

SAMSON FOX, C. E., Manager.

Best Yorkshire Steel (Siemens') Boiler Plates.

J. BEAVOR-WEBB, 76 Wall St., New York,

AMERICAN AND CANADIAN AGENT.

Locomotive Engines

FOR SALE.

The Manhattan Railway Co. has for sale, eight engines withdrawn from service, owing to light weight. They are in good condition, and of the following general description:

Weight, 13 tons.
Gauge, 4 ft., 8½ in.
Cylinder, 10x14.
Four 38 in. Drivers, no truck wheels.
Tank capacity, 300 gals.
Coal Box capacity, 900 lbs.
Builders, "Baldwin" and "Rhode Island."

Bids will be received until April 25th, for one or more of the above. Delivery to be made on the Company's tracks at 155th Street and 8th Avenue.

Permit to examine them may be obtained from the undersigned.

F. K. HAIN, General Manager,
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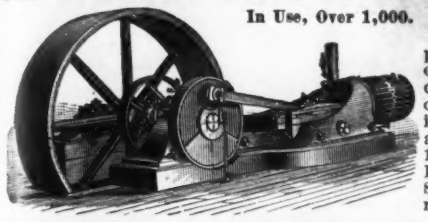
NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000.



25 to 1,000 H. P.

These Engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

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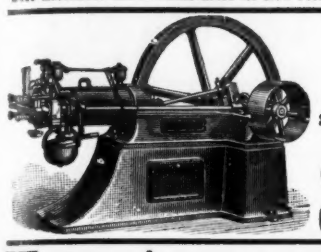
KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA,

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.



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OVER 20,000 ENGINES IN USE.

GUARANTEED To Consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work.

THE ALBANY STEAM TRAP CO.'S

BUCKET AND GRAVITATING

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Bucket.

Automatically drain the water of condensation from **HEATING COILS** and return it to the boilers whether the coils are **above** or **below** the water level in boiler, doing away with pumps and other mechanical devices for such purposes.

We also manufacture **Blessing's Patent Renewable Seat Stop and Check Valves.**—Send for Circular.

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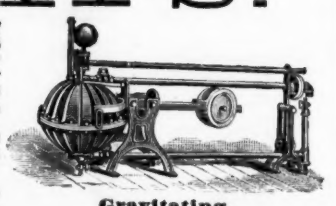
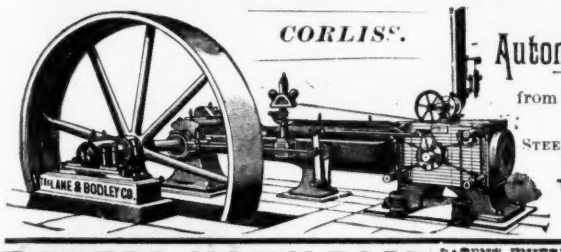


Gravitating.

The Lane & Bodley Co.



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Automatic Cut Off Engines,

from heavy patterns and of unexcelled workmanship.

STEEL BOILERS, FEED WATER HEATERS, SHAFTING, PULLEYS & GEARING.

THE LANE & BODLEY CO.

East side John, cor. Water, Cincinnati, O.

PORTER-HAMILTON ENGINE.

FOR HEAVY WORK AND LARGE POWERS.
EXTRA HEAVY DESIGN.
Send for Catalogue.

WILLIAM TOD & CO.,
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THE SKINNER ENGINE CO.

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PORTABLE AND STATIONARY
ENGINES and BOILERS
Send for Catalogue and Prices.

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The Machine Tool Business of

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Established at **14 DEY ST.**, in 1875, has been **REMOVED** to the new and commodious stores,

72 WARREN ST., AND
62 COLLEGE PLACE,

Near Chambers St. Station of the Sixth Ave. Elevated R. R.

Send for New List of Tools for immediate delivery.

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PATENT UNIVERSAL SCREW-CUTTING, CENTER, DEPTH ANGLE AND **TWIST DRILL GAUGE.**
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Fine Machinists' Tools. E. BOSTON. MASS. Send for Circular.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

To Buyers of Engine Lathes

We are now making from entirely new designs, *extra heavy* 19″ and 21″ Engine Lathes (the most popular sizes), of which we are making a specialty, and manufacturing in lots of not less than 100 at a time.

We make no charge for extras. Every lathe is furnished with *hollow spindle*, the 19″ with 1⅝″ hole, and 21″ with 1⅞″ hole. Every lathe has substantial *compound rest*, heavy tool post (bar steel), rest to turn full swing, *following rest* with adjustable jaws to take any size from 2½″ down, with extra tool for shafting.

Full set of gears to cut from 2 to 18 threads including 11½ pipe thread. *Automatic stop on carriage. Separate screw and rod feed*, and the most substantial and easily managed *taper attachment* made. Cones and gears of large diameter and wide belt. Studs, screws and small gears are *steel or gun metal*. Webbed live heads, heavy tail stocks. No worm or worm gears, no weak reverse plate. *Perfect lubrication for all running parts*, including carriage.

Lead screw inside of shear, double nut (cut from solid), and taking hold of carriage directly under the line of strain. Friction counter-shaft, the most durable made. Our prices are reasonable for cash, and from which no deviation will be made. Our written guarantee accompanies every lathe.

GUARANTEE.

We guarantee this lathe to be equal in workmanship, truth, accuracy, solidity, material and finish, to the best made, and hold ourselves legally liable for this guarantee.

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MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

Sizes Varying From

30 to 2000 Horse Power.

Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound.

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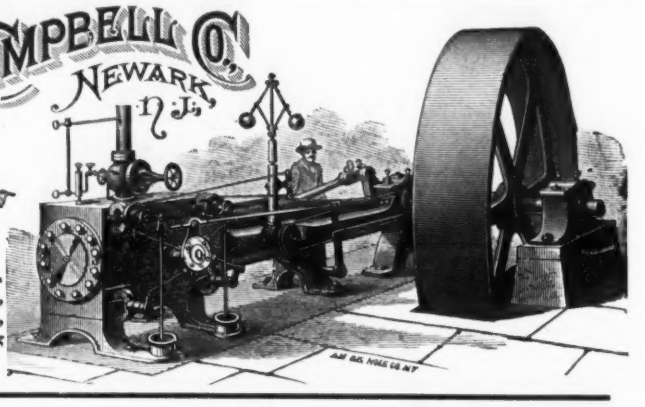

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Complete Motive Power Plants Furnished

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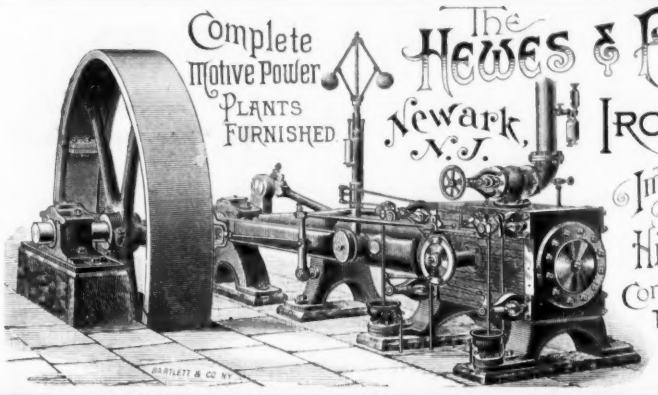

Improved CORLISS ENGINES.
High Pressure.
Condensing and Compound
TUBULAR BOILERS.
GEO. A. BARNARD
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THE IMPROVED FISHKILL CORLISS ENGINE

BUILT BY THE FISHKILL LANDING MACHINE CO.,

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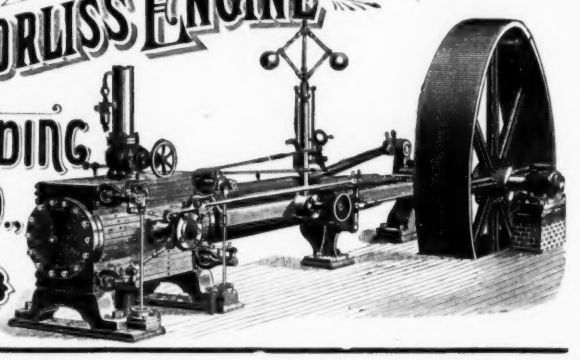

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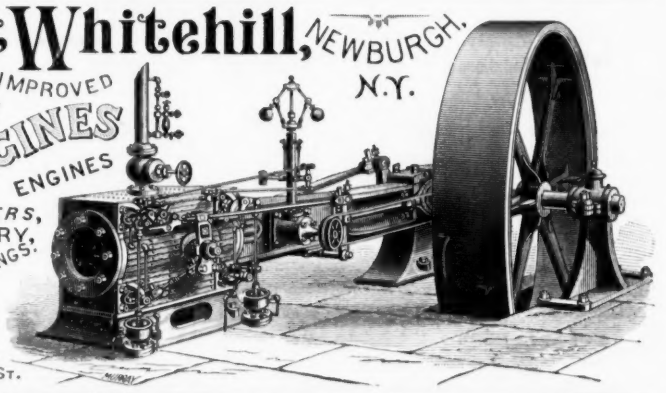
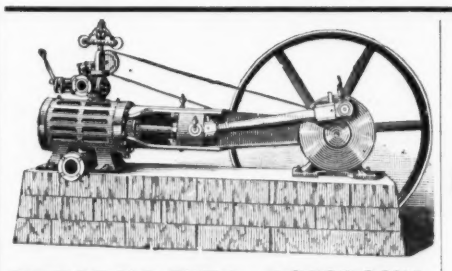
ALSO SLIDE VALVE ENGINES
STATIONARY BOILERS,
GENERAL MACHINERY,
IRON AND BRASS CASTINGS.

NEW YORK OFFICE
Room 6,
COAL AND IRON EXCHANGE,
COR. CORTLANDT & CHURCH ST.





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Engines from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

SAW MILLS and GENERAL MACHINERY.

Works at ERIE, PA.

EXTRA HEAVY LATHE

WE ARE MAKING A SPECIALTY OF A 24-INCH LATHE, WITH BED ANY LENGTH DESIRED. THIS LATHE IS DESIGNED FOR SEVERE SERVICE; IT IS THE HEAVIEST OF ITS SIZE EVER PRODUCED, AND THE WORKMANSHIP AS GOOD AS SKILL CAN MAKE IT.

SEND FOR CIRCULAR.

S. S. HEPWORTH & CO., "Glenwood Station," Yonkers, N. Y.

JOHN McLAREN,

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BUILDER OF

CORLISS ENGINES,

AIR COMPRESSORS AND BOILERS.

HILL, CLARKE & CO.

IRON AND BRASS WORKING

MACHINERY.

LATHES, PLANERS,
BOLT CUTTERS, SHAPERS,
UPRIGHT DRILLS,
BORING MILLS,
PULLEY MACHINES,
POWER HAMMERS,
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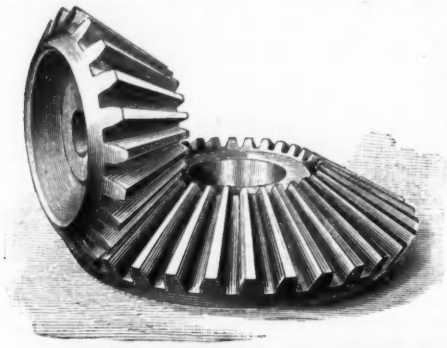
ETC.

MACHINE SHOP SUPPLIES.

36 to 42 OLIVER ST.,

BOSTON, MASS.

Accurate Bevel Gears.



By the aid of Special Machinery, we are prepared to plane Bevel Gears up to 16 inches diameter, whose ratio is not greater than 4 to 1, with the curves of the teeth theoretically correct.

This method admits of long faces, good contact and smooth running, thereby increasing durability. For patterns to cast from and in places where high speed is required, gears cut in this manner are especially desirable.

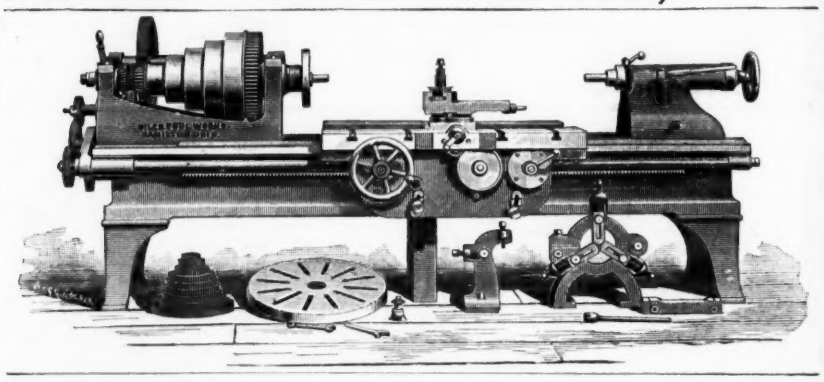
BROWN & SHARPE MFG. CO.

Makers of

Machinery and Tools,

PROVIDENCE, R. I., U. S. A

NILES TOOL WORKS, *HAMILTON,* OHIO.



Lathes, Planers, Shapers, Slotters, Etc.

POWER

TRAVELING CRANES.

Particulars on application. Full Specification and Tender promptly submitted on receipt of capacity and span of bridge desired.

MAKERS,

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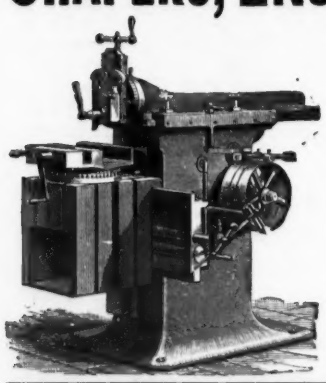
SHAPERS, ENGINE LATHES & DRILLS.



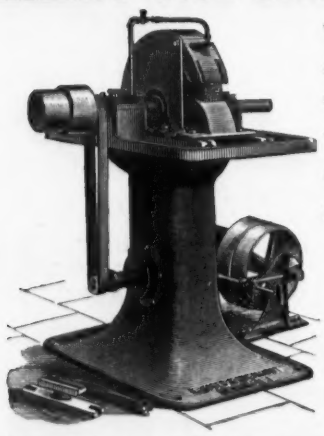
20 in. Upright Drill
24 " " "
26 " Back Geared and
30 " Power Feed
38 " Drills.

LODGE, DAVIS & CO.

CINCINNATI, OHIO.

Send for Prices. It Will Pay You.

EBERHARDT'S EMERY TOOL GRINDER



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MILLING MACHINES, DRILL PRESSES, HAND LATHES, PROFILERS, &c.

SEND FOR ONE.

THE PRATT & WHITNEY COMPANY,

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MANUFACTURE

PLANERS

to plane 16 in. x 16 in. x 3 ft., to 60 in. x 60 in. x 20 ft., with quick return motion.

PILLAR SHAPERS

with 6 in. x 10 in. stroke.

Shaping Machines

with 12 in. and 14 in. stroke, all feeds automatic.

PRICE LIST

— AND —

Discount Sheet

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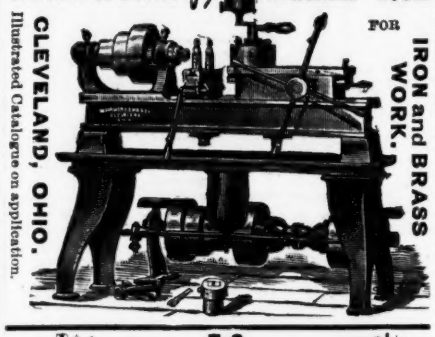

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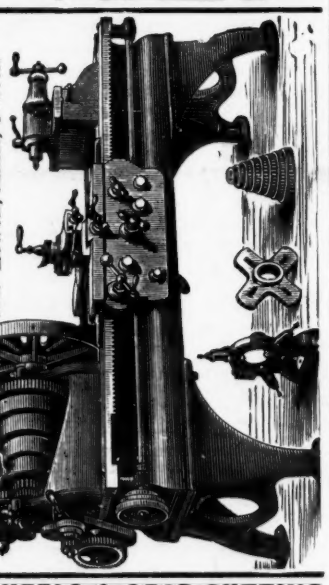

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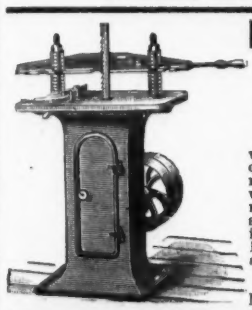

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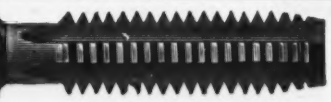

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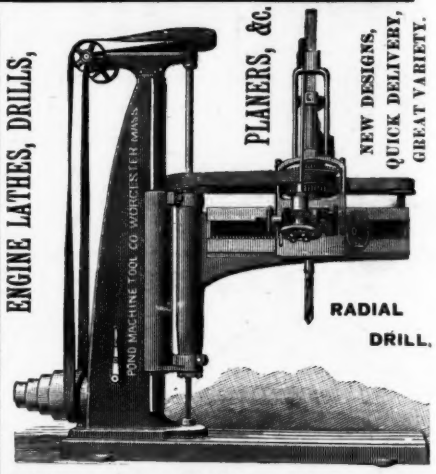

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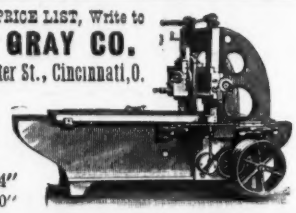
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